GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. _____

Project No. A-3333 — DATE 8/31/82

Project Director: Dr. K. P. Maddox — School/Lab TAL

Sponsor: Korea Credit Guarantee Fund (KCGF)
Seoul, Republic of Korea

Type Agreement: Agreement dated July 29, 1982

Award Period: From 8/1/82 To 7/31/83 (Performance) 10/31/83 (Reports)

Sponsor Amount: $74,546* — Contracted through:

Cost Sharing: NA — GTRI/GIT

Title: Training and Extension Services

ADMINISTRATIVE DATA — OCA Contact John W. Burdette x4820

1) Sponsor Technical Contact:

Kim Yong-Soal, Director
Extension Service Department
Korea Credit Guarantee Fund
CPO Box 1029 Dao Woo Bldg.
541, 5-KA Namdaemoonro
Choong-Ku, Seoul, Korea 100

2) Sponsor Admin/Contractual Matters:

Defense Priority Rating: NA

Security Classification: NA

RESTRICTIONS

See Attached NA Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with NA none proposed

COMMENTS:

*$13,325 to be paid directly by KCGF. Balance of $61,221 will be established as budget.

COPIES TO:

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Other _____

FORM OCA 4:781

10-2-3R306

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 10/14/1983

Project No. A-3333 ~~School~~/Lab TAL

Includes Subproject No.(s) _____

Project Director(s) Ken Maddox GTRI ~~GTI~~ XXX

Sponsor Korea Credit Guarantee Fund

Title: Training and Extension Services

Effective Completion Date: 7/31/83 (Performance) 10/31/83 (Reports)

Grant/Contract Closeout Actions Remaining:

- [ ] None
- [X] Final Invoice or Final Fiscal Report
- [ ] Closing Documents
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Continues Project No. _____

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Form OCA 58:1004

Otis Rogers/274

Proj A3333

Georgia Institute of Technology Progress Report
ENGINEERING EXPERIMENT STATION
ATLANTA, GEORGIA 30332

28 April 1983

Mr. Kim, Waan-Kee, Director
Extension Services Department
Korea Credit Guarantee Fund
Dae Woo Building
Seoul, Korea 100

Dear Mr. Kim:

Our original contract with KCGF for this year specified that reports would be sent you every three months, describing the activities of the project during the preceding three-month period. It has been brought to my attention that no reports have been written for the first two three-month periods (August-October, 1982, and November 1982-January 1983). I am writing this letter to you to explain the reason for the change in reporting schedule.

Originally, we at Georgia Tech had expected to begin work at the initiation of the contract period (that is, in August) and to have prepared and conducted training for KCGF staff as one of the first activities. However, upon the request of Mr. Kim, Yong-Sool we modified the contract, reducing the budget and eliminating the training session. This change was informally requested by Mr. Kim by letter on October 5, 1982 and formally requested in the letter Chairman and President Kim, Sang-Chan sent on October 30, 1982. Due to my absence from the office and to the Christmas holidays, final agreement on the change was not confirmed until late January, 1983.

As a result of the ongoing communications during late 1982 and early 1983, no other activity occurred on the project until Mr. Edens began preparing for his trip to Korea, which began in February. Some of Mr. Eden's research was conducted in January, but other than that work there were no technical activities during the first two quarterly periods of the project. Thus no quarterly reports were prepared for the first six months of the contract.

I hope this explanation will serve as a substitute for the reports that would have been issued had project activity occurred. If

you require further detail, please so indicate. We look forward to continuing, productive work with you on the project, and to submission of the quarterly report for February-April, 1983, which is in preparation and will be issued soon.

Yours truly,

Kenneth P. Maddox
Associate Director
Technology Applications Laboratory

KPM/ccg

Project A-3333

MANAGEMENT AND TECHNICAL ASSISTANCE PROGRAM TO KOREA CREDIT GUARANTEE FUND'S LOAN AND LEASE GUARANTEE COMPANIES

by
Larry R. Edens
Research Engineer

This quarterly report covers the period February 1 - April 30, 1983
and in particular the five weeks of field engineering work
from February 19 to March 25, 1983

Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332, U.S.A.

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INTRODUCTION

This report covers the third quarter of the fifth year of the GIT/KCGF project and highlights field activities from February 19 to March 25, 1983. During this period the GIT field engineer, Mr. Larry Edens, made 17 visits to seven companies. The purpose of these visits was to provide information and assistance on problems identified on previous field visits and to handle new requests and problems identified in the interim period.

By agreement between KCGF and GIT, priority problmes for each company were pre-selected through consultation with company managers at the end of the fourth project year. Approximately three man-weeks of research time were spent on these priority problems for the seven companies before the GIT field engineer departed for Korea. After the priority problems were addressed, assistance was provided on other problems as time permitted.

The GIT field engineer was well received at all the companies and was permitted to observe the complete manufacturing operations at each facility. The companies that were visited varied in need for assistance, and some management personnel exhibited more preparation than others. In retrospect, the consultant feels that the assistance provided to five of the companies was highly effective and efforts to help the other two were only moderately successful. Also, the GIT consultant shared his experience and expertise related to extension services and technology transfer with various members of the KCGF staff.

The KCGF staff did an excellent job in scheduling the company visits and in logistically supporting the GIT consultant. Reporting requirements were minimal and the GIT consultant was able to devote the maximum amount of time directly to the task of technical assistance. Communication problems between the GIT consultant and the clients were minimized by the KCGF staff's knowledge of the English language and understanding of technical matters.

During April a second engineer, Dr. James Bannerman, began his field visit to Korea, following research activities conducted in March. As his visit extends into the next quarter of the project year, a full report of his research and field visit will be included in the next report.

SUMMARY

The following section provides a summary of the technical assistance activities for each company visited by Mr. Edens from February 19 to March 25. A draft copy of this summary was presented to KGCF prior to departure from Korea on March 25, 1983.

SUMMARY REPORT
5TH YEAR KCGF/GIT PROJECT - 1ST VISIT
FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Dong Bang Electronics Co. Ltd. (Q) Fire Detector and Alarm Systems	2/21/83 Seon, Yong-Hoon 3/4/83 Shin, Jung-Sup 3/18/83 Shin, Jung-Sup	1. Improvements needed to the manual painting operation to increase efficiency and productivity.	2. Improvements need to be made in the assembly method for the fire alarm bell system. Currently, 30% of the alarm bell assembly units are rejected at the final inspection for failure to meet sound level standard. 3. A simpler method is needed for checking the air-tight seal on the small fire detector cases. Presently, a glass capillary is used which is mounted through a steel nut welded to the case. Leaks often occur around the welds.	1. . Provided a simplified layout for an improved painting operation which would include the use of an overhead conveyor and a continuous oven. . Provided copy of "Metals Handbook" section on painting of steel and cast iron. 2. . Presented to company a proposed 3-step method to improve precision and reliability in the asembly of the alarm bell units. . Designed a point assembly locating jig to improve precision when used with gage measurements of the point gap as recommended in above method. 3. . Provided copy of "Mechanical Design and Systems Handbook" section on adhesive bonding. . Discussed with company their idea for replacing the glass capillary system with a rubber plug through which a needle could be inserted to check for seal. This approach to problem was encouraged.	2. Follow-up needed on the use of the point assembly locator jig. 3. Follow-up needed on use of the rubber plug for checking fire detector seal.	The company management is very innovative and receptive to ideas for improving products and assembly methods. The development of the point assembly locator jig and the use of a gage in setting the point gap should reduce rejects at the final inspection of the fire alarm bell assemblies. The company has already ordered some sample silicone rubber plugs to be tested as replacement of the glass capillary system. If successful, the change in design will eliminate many quality problems. Major changes to the painting operation are not justified at this time. The firm makes over 200 products and the volume of individual products must be greater before an acceptable payback could be realized from automation.

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FIELD ENGINEER - LARRY R. EDENS

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Kyung-Won Ferrite Co. (F) Ferrite Magnet Products	2/22/83 Seon, Yong-Hoon 3/7/83 Shin, Jung-Sup	1. Information requested on the design and manufacture of ferrite ring magnets. 2. Information on the design of magnetizing coils.	1. The company's mixing and sizing (screening) equipment is very antiquated. Drying equipment is inadequate--some drying was being accomplished by spreading material on top of the heat treatment oven. Entire facility is old, crowded, and poorly lighted. 2. The major quality problem is the deviations in the ring's magnetic field from the desired levels. This causes increased current consumption in the motors. Sample testing indicates that the company has been using the same magnetizing coil since last year for the 31 mm ring.	1. Provided copy of "Metals Handbook" section on magnetic, electrical, and other special purpose materials. . Provided 4 recent articles from technical journals on the manufacture of permanent magnets, which included information on alloy compositions, particle size control and lubrication. 2. The company confirmed that most of 31 mm rings since last year were magnetized on the same coil. The importance of developing an improved coil design was discussed with the company staff. No helpful information was found in the literature on this topic. Recommended that the firm try a coil with a slightly narrower yoke and less wire turns. The field levels produced now are stronger than required. Variations in field could be caused by uneven gap between ring magnet and magnetizing coil.	2. Follow-up with company by KCGF staff to encourage improvement of the magnetizing coil. Assistance could be obtained from a motor winding shop to develop a better coil by trial and error.	The company management is receptive of assistance, but their time is limited because of heavy involvement in the daily operation of the shop. Much of the equipment and the overall facilities are antiquated. The company management will probably continue to need outside assistance on technical matters in order to improve the quality of products.

SUMMARY REPORT
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FIELD ENGINEER - LARRY R. EDENS

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Saehan Electric Wire Co. Ltd. (G) Electric Wire and Cable Products	2/23/83 Seon, Yong-Hoon 3/8/83 Shin, Jung-Sup	1. Quality control of cable insulation. . Low elongation of PE insulation on 22 KV cable. . Separation of nylon cover on PE insulation of military transmission wire. . Temperature control of PE and PVC jacket materials. . Need improved methods for printing on wire/cable insulation. . Need in-line instrumentation to measure wire and insulation diameter. 2. Information needed on copper wire drawing and annealing, in particular on the "vacuum" annealing process. 3. Copper wire plating problems because of excessive oxidation on the surface of the molten tin bath. 4. Information needed on the manufacture of flat cable. 5. Information needed on the manufacture of large diameter telephone cable.	1. Excessive vibration and movement was noticed in the extruding heads which resulted in a wave effect on the large diameter insulation. 2. The company has purchased a new wire drawing system which has solved some problems in drawing and annealing. 3. The surface of the tin bath was covered with oxidized material (dross). Part of the problem in plating could be solved by regular maintenance and cleaning of the bath. 4. The company has an extremely broad product line and seems interested in developing new products to cover every segment of the wire and cable market. This may not be practical considering the limitations of their present plant. 5. The plant tour revealed a high incidence of safety hazards, primarily the lack of proper guarding around heavy equipment and exposed or worn electrical wiring and connectors.	1. Provided copies of 20 recent articles from technical journals on the insulation of wire and cable products. . Provided a package of information by Union Carbide Corp. on wire and cable insulation, including product data sheets and technical papers. . Discussed with the company engineers the operation of the ink-jet printer which is being developed by Western Electric. The system can be controlled by a small computer. 2. Provided copies of 10 recent articles from technical journals on copper wire drawing and annealing. These included 2 articles on the "vacuum" process. 3. Discussed proper care of the tin bath with the company staff. U.S. tech. representative did not recommend the use of flux. . Recommended the use of a protective gas tinning operation which would be directly in-line with the wire drawing process. Provided technical paper by Stoiber from Wire Industry, May 1981, on this system. Tin loss is reduced to almost zero. 4. Provided 3 technical papers on the design and production of flat cable. 5. Provided copies of product catalogs and data sheets from 6 U.S. companies on wire and telephone cables.	1. The company is interested in additional information on the ink-jet cable and wire printer. The G.I.T. consultant will contact the Western Electric Co. to determine the status of this development. 2. The company has extreme interest in entering the flat cable market. It was requested that G.I.T. investigate any possibilities for a joint venture between Saehan and a U.S. company with flat cable technology.	The company has several technical staff members and they are very receptive of technical information., Their efforts at times appears to be more oriented towards new product development than towards product improvement. Based on limited contact, the G.I.T. consultant recommends that the company strive to improve its quality of products and somewhat limit its product lines over the short term. The company has plans for a large facility in the southern part of the country.

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FIELD ENGINEER - LARRY R. EDENS

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Sammi Enterprise Co. Ltd. (P) Loud-speakers and Speaker Systems	2/24/83 Seon, Yong-Hoon 3/11/83 Shin, Jung-Sup 3/22/83 Shin, Jung-Sup	1. Assistance needed in improving use of integrated circuits in megaphone products. 2. Information needed on methods for producing paper speaker cones, including paper composition data, types of cone forming equipment, and improved adhesives. 3. Information needed on the design of magnetic field and voice coil systems. 4. Information on automatic speaker testing equipment.	1. The battery system of the SAM 34R megaphone will operate at acceptable amplification and clarity for only 3-5 hours instead of the design specification of 6+ hours. 2. The company is interested in using a cone forming system referred to as the "Heat Shock Method." The method is reportedly used in Japan. . Need product data on adhesives which will not deteriorate at higher temperatures. 3. Company products with higher performance levels incur problems from overheating voice coils. Need information on design methods to reduce voice coil temperatures.	1. Provided information from Mr. Harris Johnson (G.I.T.) on the design of integrated circuits for megaphones. Provided specification sheets for National Semiconductor Company I.C.s (LM 386L, LM 389, and LM 2002A) which may be suitable for their application. Johnson gave several suggestions for redesign of the system. 2. Provided copies of 5 recent technical articles on improved designs for speakers. Discussed the present trend towards plastic and graphite cone materials with the company management. . Provided a copy of a special Application Development Report by Loctite Corporation entitled "Audio Speaker Seminar" which includes an in-depth evaluation of adhesives used in speaker construction. 3. Loaned the company a technical handbook--<u>High Performance Loudspeakers</u>, Martin Colloms, 2nd ed., John Wiley & Sons, 1980--which provides detailed information on voice coil design. The firm made a copy of the needed material. 4. Provided a technical article from the <u>Journal of Audio Engineering</u> on "Production Testing of Loudspeakers Using Digital Techniques." Conducted an in-depth discussion of this article with the technical manager.	2. The company is interested in additional information on new materials and methods for speaker construction. . Need information on the availability of technology for graphite cones. . Need information about the "Heat Shock Method" of cone forming. 4. Need additional data on automatic loudspeaker performance measurements and computer-based analysis of speaker units. Need catalogs of available equipment. 5. The G.I.T. consultant will provide the company with information about membership in the Audio-Engineering Society. They need to receive the <u>Journal</u>.	On the third visit to this company it was apparent that the managing director and technical manager had carefully studied and reviewed all of the materials provided on earlier visits. They were very appreciative of the assistance provided. The firm has well developed plans to up-grade the quality of its speaker products. They have a keen interest in new technical developments and will utilize much of the information.

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Shin Il Precision Co. Ltd. (L) Small Electric Motors, Timers, and Switching Devices	2/25/83 Seon, Yong-Hoon 3/14/83 Shin, Jung-Sup	1. Company needs design information on shaded-pole induction motors, including materials of construction for coils, core, and rotor. . Data are needed on the treatment method used to obtain black, oxidation-resistant, surface on cores. . A comparison of DuPont "Delrin 500 CL" and Japanese "Duracon Mod" acetal resins in needed. 2. Information on effects of manual versus automatic coil winding on the magnetic field that is generated.	1. Comparison data on acetal resins are no longer needed. 3. The company has now undertaken the production of a small synchronous (stepping) motor with 12 and 24 poles. Design information is needed for this type motor.	1. Information on shaded-pole motor design was provided from the following handbooks: (a) Machine Design--The Electric Motor Book (b) Electric Motor Handbook (c) Fractional Horsepower Electric Motors . Provided copies of 5 recent technical articles on the design of shaded-pole motors. . Discussed with the company staff the advantages of using a continuous copper ring (stamped) instead of welded wire for the shading coil. . Provided information on the carburizing of steel for surface hardening and protection against oxidation. 2. Provided information on manual versus automatic coil winding from Coil Winding, W. Querfurth, 3rd ed., 1968.	3. The company needs information on design and manufacturing methods for small synchronous motors. 4. In general, the company needs to develop a library of technical information on small electric motors. The G.I.T. consultant will obtain publishers' lists of motor related reference books for the company.	This company is essentially copying proven or rather standard designs for small electric motors and manufacturing them for export. However, the staff has little understanding of the motor theory or the effect of changes in the design parameters. They are very eager to increase their knowledge of these products. The assistance provided was greatly appreciated and gaive the technical stafff their first hard technical material on small motors. The company appears exceptionally well managed and efficiently operated.

SUMMARY REPORT
5TH YEAR KCGF/GIT PROJECT - 1ST VISIT
FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUS OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Sam Jung Electic Ind. Co. Ltd. (M) Automobile Radios and Tape Players	2/28/83 Shin, Jung-Sup 3/15/83 Shin, Jung-Sup 3/22/83 Shin, Jung-Sup	1. Noise problems caused by auto radio testing. 2. Quality control improvement needed to reduce the 6% reject rate at final inspection. 3. The company wants ideas for improving the product development process by changes in the organizational structure or inter-departmental relationships.	1. By discussing the audio testing process with the company staff and a noise consultant in the U.S., the G.I.T. engineer concluded that the problem (although a nuisance) was unlikely to be a health hazard. The actual periods of high level noise are very short. This testing procedure is commonly used in the U.S. and meets OSHA requirements. 2. The quality control tests, made in-process on each unit and the final inspection sample testing, are highly technical and require sophisticated test equipment and procedures. Copies of the final inspection forms were obtained. 3. Separate departments such as engineering, marketing, and production seem to operate rather independently. The main administrative office is in Seoul, but the Production Plant is at Yongin.	1. The plant noise problem due to product testing is not considered a high priority item. No recommendations were made to expend capital to reduce the noise level. 2. All in-plant time was used to investigate the complicated process of quality control testing. Due to the large number of tests required, it would be advantageous to set up a computer controlled system to perform a sequence of testing and analyze the results. The G.I.T. consultant has neither the electronic experience nor the resource materials on hand to offer assistance during this visit on the specific equipment needed. . Information on general quality control practices was provided as follows: (a) Quality Control Handbook, 3rd ed., 1974. Section 38 - Electronic Components and Section 41 - Assembly Control. (b) Industrial Engineering Handbook, 3rd ed., 1971. Section 8, Chapter 5 - Quality Control.	2. The G.I.T. consultant will discuss the testing requirements (as shown on sample inspection forms) with an electronics engineer in the U.S. Recomendations will be made to the company on computerized testing systems. 3. Problems in product development organizational methods will be addressed by Dr. Bannerman (G.I.T.) in April/May.	The results from field visits to this company were limited because of two reasons: (1) The company management was not well prepared for the initial visit. This may have been due to lack of inter-departmental coordination. (2) The G.I.T. consultant has very limited knowledge and experience in specific quality control testing in the electronic field and suitable reference resources were not available at KCGF. However, the plant (Yongin) quality control manager was highly interested in any assistance which could help automate the Q.C. testing work required. The company wants to expand production by 50% to about 30/000 units/month.

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FIELD ENGINEER - LARRY R. EDENS

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Buk Doo Eumhyang Co. Ltd. (O) Speakers and Speaker System Assembly	3/2/83 Seon, Yong-Hoon 3/16/83 Seon, Yong-Hoon	1. Information needed on paper cone speaker technology. 2. Information needed on adhesive technology application to speaker production (Other previously observed problems related to inventory control computer will be addressed by Dr. Bannerman in April/May.)	1. The company presently purchases all speaker cones from other companies. But, they want to eventually design and produce cones. Interested in licensing a process. . The company would like information on Holly Speakers (U.S.A.) . Management is interested in information on the Audio-Engineering Society. 2. The company asked for recommendations for an adbesive to bond a rubber gasket to a mylar film cone. 3. Requested information on an integrated quality control system for production of electronic products.	1. Provided copies of 5 recent articles on improved designs for speakers. Discussed the trend towards the use of plastic and graphite cone materials. . Discussed the problems of acquiring technical information in the highly secretive cone technology field. The licensing of a process was encouraged as a means of entering the top-quality market. 2. Provided a copy of a special application development report by Loctite Corporation entitled "Audio Speaker Seminar" which includes an in-depth evaluation of adhesives used in speaker construction. . Recommended ethyl-cyanoacrylate (Loctite 420, 495, or 414) for bonding the rubber gasket to a mylar cone. 3. Provided a technical article from the Journal of Audio-Engineering on "Production Testing of Loud-Speakers Using Digital Techniques." Discussed use of computer systems in quality control.	1. Upon return to U.S., the G.I.T. consultant will send to the company (via KCGF) information on: (1) Holly Speakers (2) The Audio-Engineering Society	The management was particularly appreciative of assistance in adhesive applications. They seem,to have problems getting technical assistance or information from U.S. companies from which they purchase products. This company is very progressive and during the visit period moved manufacturing operations to a new plant about 20 miles north of Seoul. The plant site has space allocated for the location of sub-contractors or major part suppliers.

DONG BANG ELECTRONICS COMPANY, LTD.
(Company Q)

Dates Visited: February 21, March 4, and March 18, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon
Mr. Shin, Jung-Sup

Principal Products: Fire Detector and Alarm Systems

Previously Observed Problems or Questions

At the last visit by a GIT field engineer in the spring of 1982, the area targeted for technical assistance work was the manual painting operation. However, detailed discussions with the management revealed that a highly automated painting line is not practical because of the large number of low volume products being manufactured by the company. Products total over 200 items. The painting area is presently undersized but any expansion would definitely require an addition to the building.

Observed Problems or Questions During Current Period

During the initial visit, it was found that the company was experiencing serious problems in assembling a major new product -- a fire alarm bell. Trial and error methods were being used for properly locating sub-assemblies and the end result was a 30% reject rate at the final inspection. The standard for the final inspection requires that the bells have a sound level output of 90 dB at 1 meter. Rework of the reject bell assemblies requires considerable time and greatly reduces productivity.

Another technical problem was causing high rejects in the production of a small fire detector unit (another new product). The detector unit requires an airtight bulb. A small glass capillary was currently used for checking the seal of the bulb -- then the capillary tube was closed. However, the capillary tube was mounted in an assembly which required welding a steel nut onto the bulb. This weld was in itself a major cause of leaks.

Action During the Current Period

A proposed plan for using an overhead monorail and a continuous oven was sketched for the company should the volume of specific products increase to the level where painting capacity must be expanded. See Exhibit A. The GIT consultant provided a copy of "Painting of Steel and Cast Iron" from the Metals Handbook, pp. 548-563.

On the second visit to the company, a three-step method was proposed for standardizing the assembly of the fire alarm unit. The procedure is outlined in the attached Exhibit B. It was found that the company had already developed a gage for precisely locating the coil bracket (Step 2 of Exhibit B); but the company's Technical Director expressed the need for a jig to locate the point assembly in Step 3 and hold it in position while fastening it to the coil housing. A point assembly locating jig was designed as shown in Exhibit C and presented to the company on the third visit. The company plans to use the assembly methods proposed by the consultant and develop a locating jig using the recommended toggle clamp and cam devices. Design information for the cam and toggle was provided from pages 108-112, Jig and Fixture Design Manual, Erick K. Henriksen, 1973.

At the second visit, the possibility of replacing the glass capillary assembly on the fire detector unit was discussed. The best alternate may be a soft rubber plug which would be stable at temperatures over the range -10°C to +60°C. The airtight seal could be checked by inserting a hollow needle through the rubber plug. Prior to the third visit, the Technical Director had ordered sample plugs of silicone rubber for testing and evaluation.

Future Company Requirements

The company will need follow-up assistance on the use of the point assembly locator jig and the testing of the rubber plug as a method of checking the fire detector seal. This assistance could be provided either by KCGF or GIT staff.

Observed Results and Company Reaction

This company has a broad product line of over 200 items. Lately, the firm has developed more sophisticated electronic products which require improved control over materials of construction and assembly practices. Company management is aware of these requirements and is very innovative and receptive to new ideas. The assistance provided during this period should reduce rejects and improve the quality of the fire alarm and fire detector units.

DONG BANG ELECTRONIC COMPANY LTD.
PAINTING SHOP

FIG 1.
EXISTING

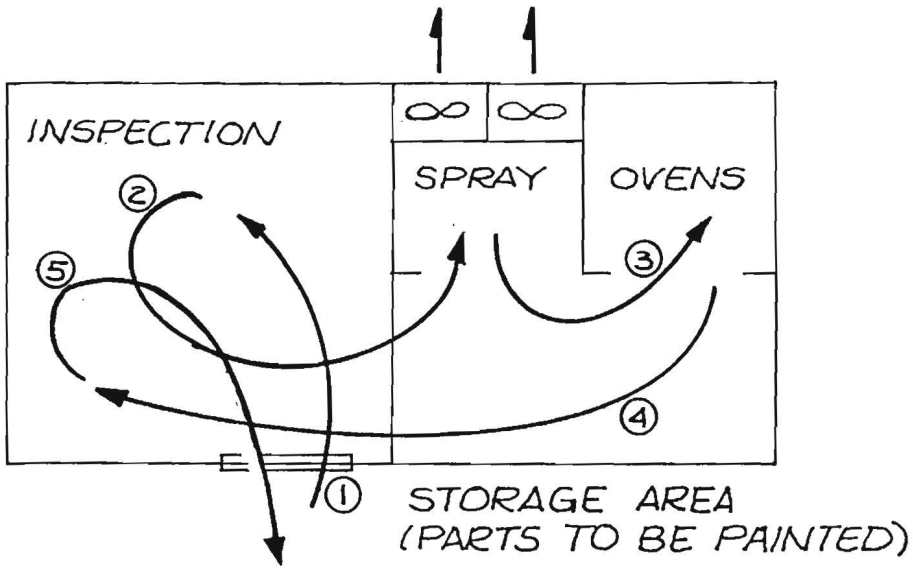
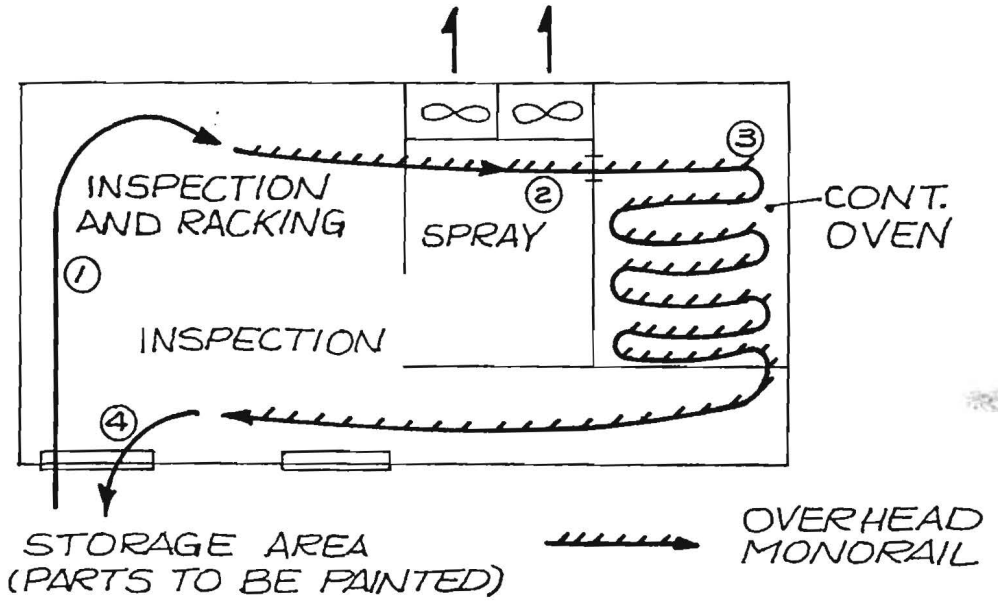


FIG 2.
PROPOSED



Company: Dong Bang Electronics Co.

Problem: Assembly of Alarm Bell to Achieve Maximum Sound Level

Step 1: Always attach coil housing to bell at the same precise setting. This should be a fairly close tolerance fit.

Step 2: Position the bell coil bracket precisely in relation to the coil housing. The coil rod should be centered in the drilled hole in the housing. A gage should be made to properly locate the coil bracket before fastening with screws. (Fig. A.)

Step 3: Locate points assembly by setting point gap (check with gage) when coil rod is depressed and in contact with bell. (Fig. B.)

Field Engr. - L. Edens
Mar. 4, 1983

FIG A. COIL BRACKET GAGE

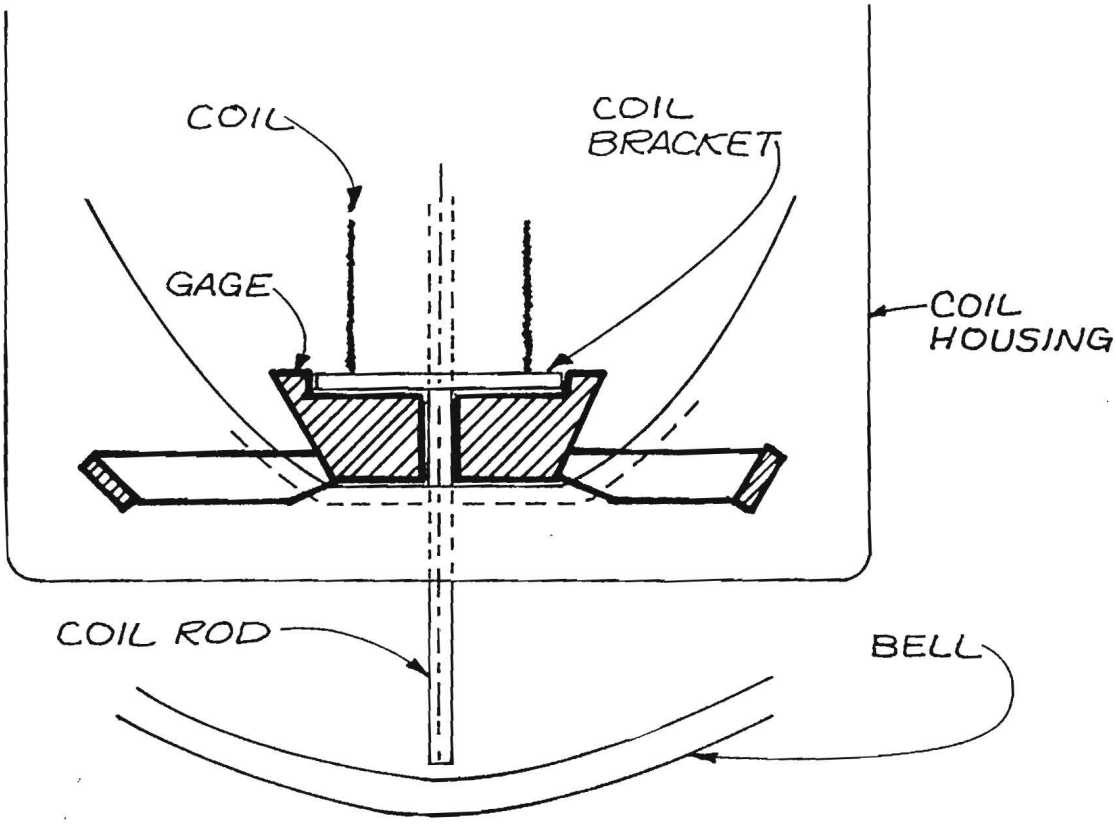
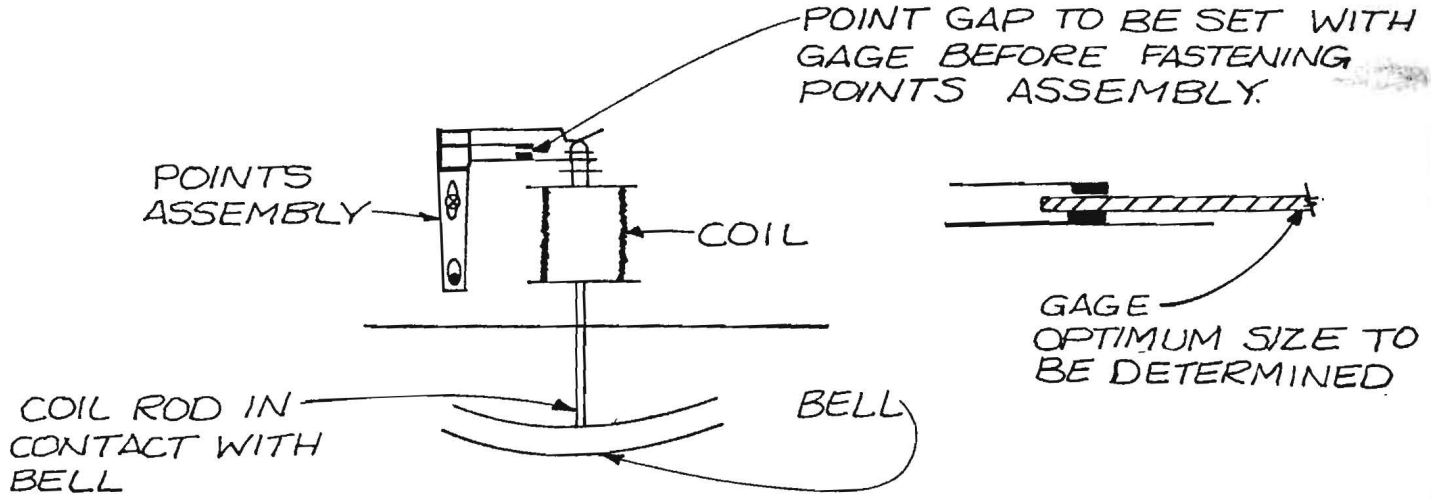
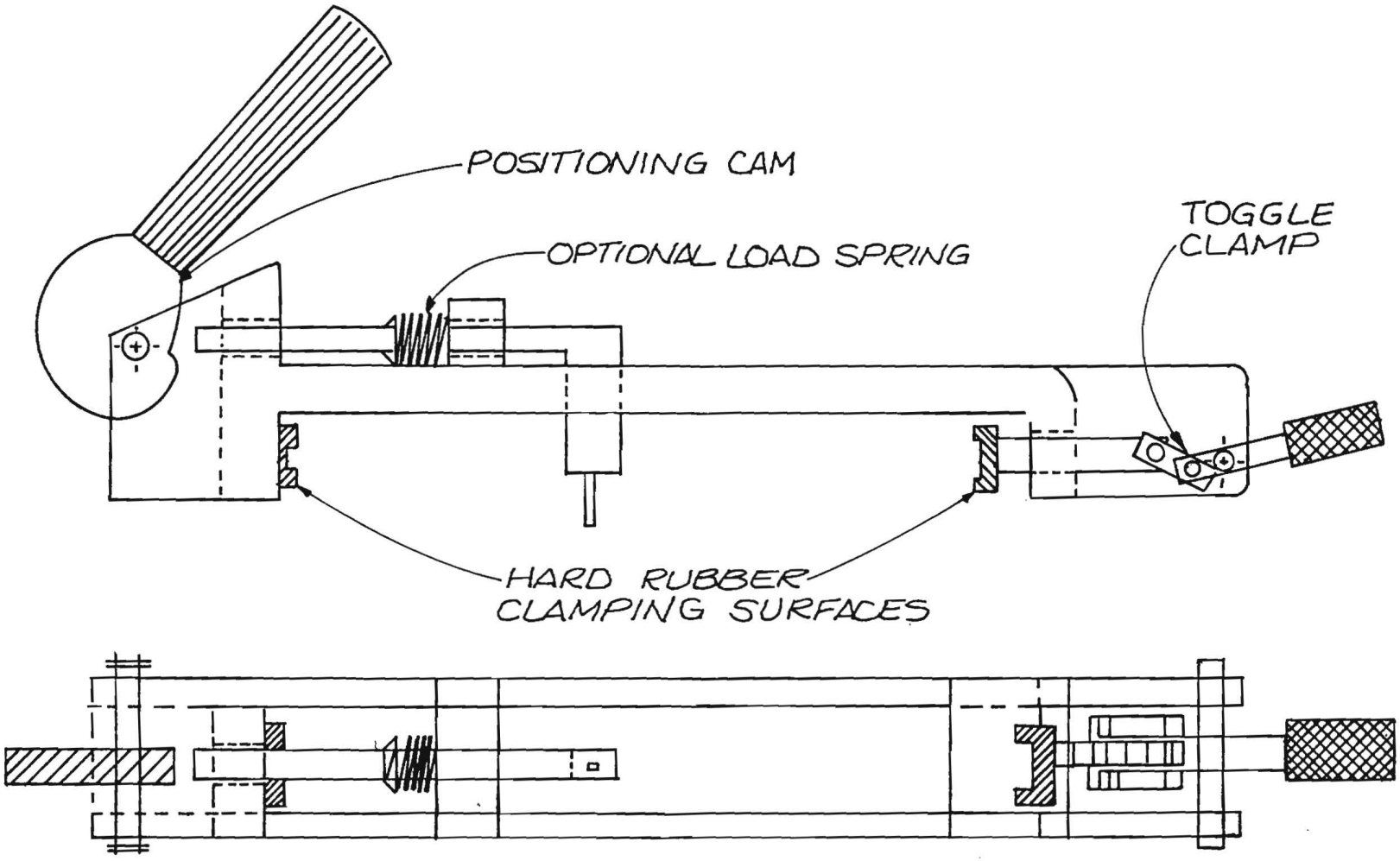


FIG. B.





PROPOSED POINT ASSEMBLY LOCATING JIG
FOR
DONG BANG ELECTRONICS CO. LTD.

EXHIBIT C

KYUNG-WON FERRITE COMPANY
(Company F)

Dates Visited: February 22 and March 7, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon
Mr. Shin, Jung-Sup

Principal Products: Ferrite Magnets

Previously Observed Problems or Questions

During the previous visit by a GIT consultant, the company management expressed a need for design information for making ring magnets and magnetizing coils. In general, the firm needs to improve the control over the manufacturing process to upgrade the quality of the product.

Observed Problems or Questions During Current Period

This firm's operation is housed in substandard facilities with poor access roads. Much of the equipment is antiquated. In spite of these limitations, the company is apparently successfully supplying the rapidly growing Korean small motor industry. The major problems at the company are related to the quality control of ring magnets to meet dimensional and magnetic field requirements. Quality improvement opportunities should be investigated for the following operations: powder composition; powder mixing and screening; heat treating or sintering; and magnetizing.

Action During Current Period

An in depth investigation of the ring magnet quality problems indicated that the magnetic field variations from the target values were probably resulting largely from the magnetizing process itself. The GIT field engineer noted that the field strengths of the 31 mm rings sampled on 2/22/83 were very similar to the values reported by the GIT consultant who visited the plant in the spring of 1982. The plant manager confirmed that all of the

31 mm rings (except rejects for size) over the past year had been magnetized on the same coil. The variation from target values is shown in the following table:

	Magnetic Field of 31 mm Rings (Gauss)					
	N	NW	SW	S	SE	NE
Average Samples (2/22/83)	620	690	720	620	670	670
Samples (5/82)	600	680	650	610	650	640
Target Values	500	600	600	500	600	600

The overall magnetic field is much stronger than the target values. The coil now used was made by the company on a trial and error basis. Uneven windings or gaps may be causing the field variations in the rings. The manager stated that they used about 30-35 turns of copper coil wire covered with a ceramic material. The firm had started making additional magnetizing coils some months ago but had never finished them. It was recommended that they make (or have made by an electrical motor winding shop) another coil with a deeper yoke and a few less turns.

The following technical articles on materials of construction and manufacture of P/M ring magnets were provided for the company and discussed with the managers:

1. "Magnetic, Electrical, and Other Special Purpose Materials," Metals Handbook, Vol. I. pp. 779-96.
2. "Will Magnets Get Better--Costs Come Down?" Robert W. Lee, Automotive Engineering, April 1978. pp. 59-61.
3. "The Importance of Powder Particle Size and Flow Behavior in the Production of PM Parts for Soft Magnetic Applications," M. H. Khan, International Journal of Powder Metallurgy, Vol. 16, No. 2, 1980. pp. 123-130.
4. "New Metallic Alloys," G. Y. Chin, Science, Vol 208, May 1980. pp. 888-894.

Future Company Requirements

This company needed more in-plant assistance than could be made available under the limitations of the field engineer's assignment. The firm needs follow-up assistance to encourage improvements in the magnetizing coil and upgrading of the facilities in general.

Observed Results and Company Reactions

The company is very limited in technical expertise and although appreciative of assistance the company management has limited time for development work because of their heavy involvement in the daily operation of the shop. The GIT consultant strongly believes that this firm will continue to need outside assistance on technical matters in order to improve the quality of its products and to remain competitive. Simply providing technical information to this company may not be effective -- in-plant assistance may be required for implementation.

SAEHAN ELECTRIC WIRE COMPANY, LTD.
(Company G)

Dates Visited: February 22 and March 8, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon
Mr. Shin, Jung-Sup

Principal Products: Electric Wire and Cable

Previously Observed Problems or Questions

During the previous visit by a GIT consultant, the company listed a large number of problem areas and requested technical information related to them. The technical problem areas included:

(1) Temperature control of PE and PVC jacket materials

(2) Drawing and annealing processes for copper and aluminum wire

(3) Information needed on the "vacuum" annealing process

(4) Automatic, on line wire and insulation measuring (diameter) equipment

(5) Oxidation control on the molten tin plating line

(6) Break prevention in nylon wire coverings

(7) Improved methods for printing on wire and cable products

(8) Information on manufacturing process for flat cable

(9) Information on "steam" and "gas" methods for curing PE

(10) Information on manufacturing large diameter telephone cables

(11) Data on cable taping (or wrapping) machines

Observed Problems or Questions During Current Period

On the initial visit to this company, it was confirmed that the technical staff was still interested in receiving technical information on all of the problem areas listed above. The company has several engineers on the staff

and a significant new product development effort. The GIT consultant concluded that this company could be best assisted by the delivery of state-of-the-art information rather than by in-plant work.

The plant operations are crowded; the company plans to move to a larger facility in the southern part of the country in the near future. The purchase of a new wire drawing line in 1982 has solved some of their drawing and annealing problems. The GIT field engineer noticed the following problems during the plant tour:

(1) Excessive vibration of extruding heads resulted in a wave effect on large diameter wire insulation -- improved machine anchoring was recommended.

(2) The surface of the tin plating bath was heavily covered with dross -- regular maintenance and cleaning of the tin bath was recommended.

(3) Employees have a high exposure to safety hazards such as the lack of machine guarding and exposed electrical wires and connectors.

Action During the Current Period

The GIT consultant presented the client with articles from technical publications and sections from catalogs related to their areas of interest as follows:

Articles

1. "Wire Manufacturing--Testing and Control," A. E. Hartman, Wire Journal, March 1974. pp. 65-72.
2. "Drawing of Copper Wire," Franco Paparoni, The Wire Industry, November 1966. pp. 1067-72.
3. "High Speed Strand Annealing of Copper Wire," D. Boxall, The Wire Industry, December 1966. pp. 1167-8.
4. "Some Modern Developments in Copper Wire Drawing," S. Harper, et al, Metals and Materials, August 1970. pp. 335-9.

5. "Nondestructive Monitoring of Copper Wire," Z. A. Davydova, et al, Zavodskaya Laboratorija, Vol. 46, No. 8, August 1980. pp. 749-750.

6. "Flat Cable and Its Connector Systems," Jim McDermott, EDN, January 7, 1981. pp. 108-138.

7. "Wire and Cable--What's Happening?" Jack Hickey, Instruments and Control Systems, August 1980. pp. 39-42.

8. "Sub-Atmospheric Pressure or Vacuum Heat-Treatment Processing," T. Bell, Metals Technology, May 1974. pp. 209-221.

9. "Protective Gas Tinning Plant for Copper Wires," Siegfried Stoiber, Wire Industry, May 1981. pp. 342-4.

10. "The Chance for a Better ROI as a Result of Higher Speeds in Non-ferrous Wire Drawing," Lea Cloostermans, et al, Wire Journal, June 1978. pp. 70-76.

11. "Considerations in the Selection of Die Lines and Drawing Speeds," Edward Phillips, Wire Journal, February 1977. pp. 54-7.

12. "Inductive Thickness and Eccentricity Gage," Guy Millette, Wire Journal, January 1977. pp. 54-59.

13. "New Approach to Concentricity Measurement," James O. Corbett, et al, Wire Journal International, June 1982. pp. 56-9.

14. "Die Drool--What Causes It, How to Avoid It," Imrich Klein, Plastics World, May 1981. pp. 112-3.

15. "Three Fine Wire Drawing Systems," Frederic Krafft, Wire Journal, July 1980. pp. 103-5.

16. "Apparatus for Extruding Wires of Soft Metals Under Vacuum or Inert Atmospheres," F. X. Kayser, Review of Scientific Instruments, May 1978. pp. 639-42.

17. "What's New in Wire Machinery," Ruth Rose, Wire Journal, July 1979. pp. 98-104.

18. "A New Technique for Permanent and Non-Abrasive Marking of Plastic Cable Sheaths," Jorg Hennig, Wire Journal, July 1977. pp. 54-7.

19. "Marking Inks--A Critical Coating," David Gemelli, Wire Journal, May 1982. pp. 46-50.

20. "Noncontact Ink Jet Printer for Cable Sheath Marking," Wayne Newton, Wire Journal, April 1980. pp. 84-7.

21. "Dry Powder Coating Systems," Donald Gillette, Wire Journal, May 1982. pp. 73-83.

22. "Radiation Curing Works Best for PE Films and Wire Coatings," A. Barlow, et al, Plastics Engineering, August 1976. pp. 42-5.

23. "Developing Crosslinked Polyethylene Cables for High Voltage Power Transmission," W. G. Lawson, Electronics and Power, February 1978. pp. 116-20.

24. "Aging Investigations of Polyethylene Insulated Telephone Cables," K. Grill, Electrical Communications, Vol. 52, No. 1, 1977. pp. 80-3.

25. "Improvements in Cable Insulation," W. F. Jensen, Electrical World, May 1978. pp. 55-6.

26. "Diameter Control of Cable in Continuous Vulcanizing Lines," Charles Fitzgerald, Wire Journal, July 1978. pp. 74-9.

27. "Completely Dry Curing and Cooling Process," Matti Aalonen, Wire Journal, June 1978. pp. 64-8.

28. "Recent Developments in Continuous Compounding of PVC, XLPE, and Other Plastic Coatings for Wire and Cable," Hans J. Adam, Wire Journal, January 1978. pp. 80-7.

29. "Development and Operation of a 48-Wire Patenting and Coating Line," James Cunningham, Wire Journal, July 1977. pp. 74-7.

30. "Crosslinked Polyethylene Insulations Using the Sioplas Technology," Bryan Thomas, et al, Wire Journal, May 1977. pp. 88-92.

31. "Crosslinkable Polyethylene for Wire and Cable: An Update," Mark Itzkoff, et al, Wire Journal International, May 1982. pp. 60-71.

32. "New PE, OVC Grades Introduced for Wire and Cable," Plastics Technology, March 1979, p. 37.

33. "New Way to Crosslink PE: All You Need is Moisture," Robert Bloor, Plastics Technology, February 1981. pp. 83-6.

34. "Insulated Wire and Cable Markets," William Black, et al, Wire Journal, March 1980. pp. 120-125.

35. "New Insulation Development for Wire/Cable," Irwin Lazar, Specifying Engineer, September 1981. pp. 90-93.

Catalog Material

1. Standard Wire and Cable Company, Thomas Register. pp. 4070-4108.

2. Graybar Electric Company, Inc., Thomas Register. pp. 2069-2080.

3. Newcon Wire and Cable Corp., Thomas Register. pp. 3245-8.

4. Haartz-Mason Inc., Thomas Register. p. 2100.

5. Ja-Bar Silicone Corp., Thomas Register. p. 2501.

6. Daburn Electronics and Cable Corp., Thomas Register. pp. 1275-7.

7. Linear Low-Density PE for Telephone Cables, Union Carbide Corp, 1981.

8. Wire and Cable, Product Data Sheets, Union Carbide Corp.

9. Kabelitems, Nos. 139, 141, 153, 157, Union Carbide Corp.

Company engineers were very interested in the ink-jet printer being developed by Western Electric. The field engineer discussed the advantages of the system which can be controlled by a small computer. The GIT consultant recommended the installation of a "protective gas" tinning operation in-line with the wire drawing process to reduce tin loss and improve coating quality. The contents of a large number of the technical articles were explained to the company engineers.

Future Company Requirements

The company requested additional information on the development of the ink-jet printer and the manufacturing process for flat cable. The company is interested in obtaining flat cable technology through a joint venture or

a licensing agreement. The GIT consultant will follow up on the requests after returning to the United States.

Observed Results and Company Reactions

The firm has a very competent technical staff and they are extremely receptive of technical information. The staff carefully reviewed all publications presented by the GIT consultant. The consultant is concerned that the company may be overemphasizing a great number of new product development ideas at the expense of quality improvements on existing products.

SAMMI ENTERPRISE COMPANY, LTD.
(Company P)

Dates Visited: February 24, March 11, and March 22, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon
Mr. Shin, Jung-Sup

Principal Products: Speaker Systems

Previously Observed Problems or Questions

During the previous visit to the company by a GIT consultant in the spring of 1982, the following technical problems were identified in order of priority:

(1) Assistance is needed in selecting integrated circuits (ICs) for use in megaphone systems.

(2) Technical information is needed on paper speaker cone manufacturing.

(3) Design information requested for the magnetic circuits and voice coil wires for high performance loudspeakers.

(4) Data on improved adhesives for speaker construction.

(5) Information on methods of automatic speaker testing.

Observed Problems or Questions During Current Period

On the initial visit, the company's manager confirmed that the above technical problem areas were still of highest priority. In addition, he requested information on a speaker cone forming process called the "Heat Shock Method." Apparently the method is being used by some Japanese companies. No references to this method were found in the research publications collected in the U.S.

Action During the Current Period

The company has developed a megaphone design (SAM 34R) which uses an NEC μPC 1230 HIC integrated circuit. The SAM 34R will operate on its battery system with acceptable amplification and clarity for only 3-5 hours instead of the design expectancy of 6+ hours. The Technical Director feels that the design uses more power than it should and the amplification becomes distorted when battery power gets low. The GIT field engineer provided the Technical Director with a letter from Harris Johnson (GIT) which recommended redesign of the circuit. See Exhibit A. Also provided were specification sheets on three National Semiconductor ICs (LM 386L, LM 389, and LM 2002A) which Johnson thought may be suitable for this application.

Copies of the following technical publication articles were provided for the company:

1. Loctite Corporation Audio Speaker Seminar, Application Development Report #12, Buth Marino, September 20, 1979.
2. "Core-stiffening Struts Boost Speaker Performance," E. J. Stefanides, Design News, November 2, 1981. pp. 158-160.
3. "Design Problems of High-Level Cone Loudspeakers," John Gilliom, et al, Journal of the Audio Engineering Society, Vol. 25, No. 3, May 1977. pp. 294-9.
4. "Polymer-Graphite Composite Loudspeaker Diaphragm," T. Tsukagoshi, et al, Journal of the Audio Engineering Society, Vol. 29, No. 10, October 1981. pp. 720-5.
5. "Acrylic System Used by Stereo Speaker/Wood Beam Makers," Adhesives Age, April 1980. pp. 36-8.
6. "Production Testing of Loudspeakers Using Digital Techniques," L. R. Fincham, Journal of the Audio Engineering Society, Vol. 27, No. 12, December 1979. pp. 970-4.
7. "Plastic Film Boosts Speaker Performance," Machine Design, Vol. 53. September 24, 1981. p. 46.

Also, the following reference book was loaned to the company for several weeks during the GIT consultant's stay in Korea:

Colloms, Martin. High Performance Loudspeakers, 2nd ed., John Wiley and Sons. 1980.

Lengthy technical discussions were held between the consultant and the company staff regarding the interpretations of the articles provided. Major subjects included modern innovations in speaker design such as the use of struts, the use of graphite and plastic speaker materials, the use of plastic films on paper, and designs used to avoid voice coil heating problems in high-performance speakers. The consultant recommended that the company investigate the use of computer analysis of automatic speaker test data to make optimum pairings of stereo speaker sets.

Future Company Requirements

This firm has a continuing need for technical information on the design of high-performance loudspeakers. The management also has a need for more data on the use of computers in testing and analyzing loudspeaker performance. The GIT consultant will obtain copies of references from the above-listed Articles 3 and 6 and will provide information on membership in the Audio Engineering Society. The company needs to receive the Journal.

Observed Results and Company Reactions

The company management was most appreciative of the assistance provided and showed a keen interest in all of the research materials. On the third visit, it was evident that the staff had carefully studied and reviewed the technical literature. The firm's goal is to upgrade the quality of its products. A commedable product improvement effort is already underway. Much of the information provided through this program will be utilized.

ENGINEERING EXPERIMENT STATION
Georgia Institute of Technology
A Unit of the University System of Georgia
Atlanta, Georgia 30332

GINEERING EXTENSION LABORATORY
West Georgia Area Office
201 Tanner Street
P.O. Box 676
Carrollton, Georgia 30117
Area Code 404/834-1480

February 8, 1983

TO: Larry Edens

FROM: Harris Johnson

SUBJECT: µPC 1230 HIC

NEC, in general, has an excellent reputation in this area and unless newer devices with greater dynamic range are available (takes an engineering search/ evaluation to discover) something has to give in the described application. One trade-off is that of gain vs. battery dynamic range. Slightly less gain may improve low battery performance. Other options might include a monitor circuit to signal low battery condition and thereby preclude operation in that condition. Another option would be to use a modified AGC to reduce gain with falling battery power.

Other options exist, but they would in general require circuit redesign. As soon as I get the NEC data sheet, I'll compare it to National's version and comment.

NEC Atlanta Distributors

Marshall Elec.	(404) 923-5750
Dunwood Elec.	(404) 393-9666
Regional Representative Brant Lee Kelly	(404) 469-1515

SHIN IL PRECISION COMPANY, LTD.
(Company L)

Dates Visited: February 25 and March 14, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon
Mr. Shin, Jung-Sup

Principal Products: Small Electric Induction Motors,
Electrical Switches and Timers

Previously Observed Problems or Questions

On the previous visit by a GIT consultant, the following technical assistance and information requests were made:

(1) Design information on shaded-pole motors

(2) Surface treatment methods for motor cores

(3) Comparison data for "DURACON M90" (Japanese) and "DELRIN 500 CL" (DuPont) Acetal Resins

(4) Information on the effects of manual (uneven) coil winding versus automatic winding

Observed Problems or Questions During the Current Period

The company is developing an ice maker motor for General Electric. Essentially, they are copying a sample shaded-pole motor provided by G. E. which was made by General Industries Corp., of Ohio. However, many changes were made in the materials of construction along with minor design changes. The company now needs design information on this type motor to make improvements and resolve problems which may arise. All of the previous requests listed above pertain to the shaded-pole motor.

The comparison of "DURACON M90" and "DELRIN 500 CL" has been accomplished since the last GIT visit and no additional assistance is needed on this item.

The firm has now begun the development of a small synchronous motor (stepping motor) which will be used as a control motor for robots. Information is needed on the basic design and manufacturing methods for this type of motor. The company has a sample Japanese motor which they are copying. See Exhibit A.

Action During the Current Period

The following technical references were provided by the GIT consultant on the shaded-pole motor and coil winding techniques:

1. "Design of Small Electric Motors," E. W. Mortimer, Component Technology, (Great Britain), Vol. 3, No. 2, October 1968. pp. 26-30.
2. Veinolt, Cyril G. Fractional and Subfractional Horsepower Electric Motors, 3rd ed., Chapter 10 - Shaded Pole Induction Motors. McGraw-Hill Book Company (U.S.A.). pp. 192-213.
3. Campbell, John. Machine Design: The Electric Motor Book, 1961 ed., Chapter 10 - Fractional Horsepower Motors, General Electric Company. pp. 54-67.
4. Machine Design: The Electric Motor Book, 1961 ed., Product Directory Section (General Industries Corp.), p. 157, and (Barber-Coleman Co.) p. 176.
5. Thomas Register Catalog File, 1980 ed. Robbins and Myers Electric Motor Products. p. 3729.
6. Electric Motor Handbook, E. H. Werninck, editor, McGraw-Hill Book Company (U.K.) Limited. pp. 235-8.
7. "Effect of Parameter Changes on the Performance of Shaded-Pole Motors," O. I. Butler, et al, Proceeding IEE, Vol. 116, No. 5, May 1969. (U.K.)
8. "Characteristics of Shaded-Pole Type Linear Induction Motors," T. Matsumiya and K. Takagi, Engineering Faculty Research Report, Meiyi University (Japan), No. 35, 1978. pp. 67-72.
9. "Saving Energy with Shaded-Pole Motors," T. A. O. Gross, Machine Design, Vol. 51, July 1979. pp. 85-86.

10. "Mathematical Model of a Shaded-Pole Motor," P. Kaasik and V. Ivanov, Electrotekhnika (U.S.S.R.), Vol. 51, No. 3, 1980. pp. 7-12.

11. Coil Winding, 3rd ed., Chapter 1, William Querfurth. George Stowers Manufacturing Co., Chicago, 1968.

The consultant discussed with the technical staff the various design parameters which affect the motor output and efficiency and suggested that the firm use copper stampings for shading coils rather than welded copper wire. The stator on the General Industries motor appeared to be carburized. Technical information on the carburization process as a surface treatment method for resisting oxidation was provided.

Future Company Requirements

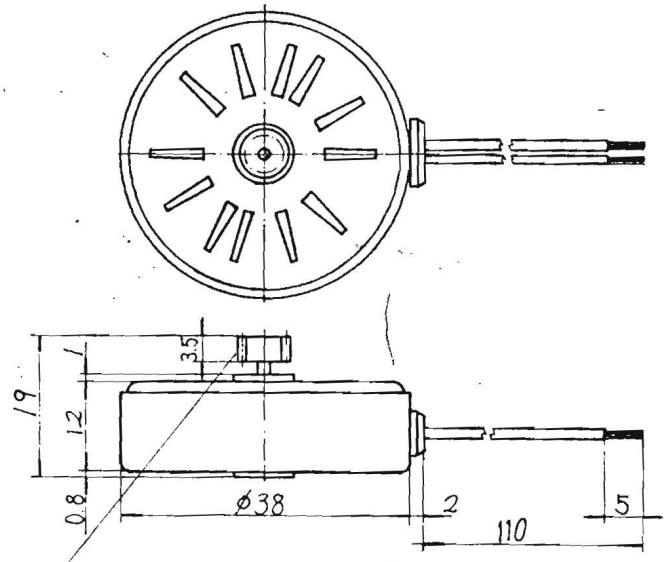
The company needs basic design information on small synchronous motors for their present development project. For the long term, however, the company needs to acquire a collection of reference materials on small motors in general. The GIT consultant will obtain publishers' lists of appropriate reference books for the company library. Presently the firm has only one small reference book on motors (Japanese).

Observed Results and Company Reactions

The information provided was obviously the staff's first exposure to hard technical material on small motor design theory. They are very eager to increase their knowledge in this field and the assistance was greatly appreciated. Small motor manufacturing promises to become an important and expanding segment of the firm's business.

The company appears to be exceptionally well managed and efficiently operated.

STEPPING MOTOR



Tooth Form	Involute
Pressure Angle	20°
Module	0.5
Teeth	10
P.C.D.	5
External Dia Meter	6.0

Ferrite Motor - Direct Drive

Synchronous Motor (SSM-24))		
Rated Voltage	V	AC 115V
Frequency	Hz	50/60
Speed	R.P.M.	250/300
Revolution Direction (By option)		C.W CCW
Input	W	1.5
Stall Torque	Cm/g	25
Weight	g	49

품번	부 품 명	수량	재 질	소 재 치 수	처 리	비 고

도면에 지정되지 않은 일반공차			
치수 \ 급수	A 급	B 급	C 급
1 - 4 이하	±0.05	±0.10	±0.25
4 - 16	±0.07	±0.20	±0.35
16 - 63	±0.10	±0.30	±0.50
63 - 250	±0.18	±0.55	±0.90
250 - 500	±0.30	±0.90	±1.50
500 - 1000	±0.60	±1.50	±2.50

제 도	설 계	검 도	확 인	승 인
제3각법	척 도	/	단 위	mm

信一精密株式會社

도명	
기종	-33-
참고도번	
도번	

SAM JUNG ELECTRIC IND. CO., LTD.
(Company M)

Dates Visited: February 23, March 15, and March 22, 1983

KCGF Staff Involved: Mr. Shin, Jung-Sup

Principal Products: Automobile Radio/Tape Players and Telephone Switching Equipment

Previously Observed Problems or Questions

During the previous visit by a GIT consultant, three priority problems were identified as follows:

(1) Noise problems caused by auto radio testing

(2) Quality Control improvements are needed to reduce the 6% reject rate for auto radios at the final inspection

(3) The firm needs assistance in improving the product development process by changing their organizational structure or inter-departmental relationships.

Observed Problems or Questions During Current Period

Plans were made at GIT for the field engineer to address only problems (1) and (2) during the current period. Problem (3) will be undertaken by the next visiting GIT consultant.

Company management confirmed that the quality control and testing of auto radio/tape players are their major technical problem areas. Although there are several Q.C. checks made prior to final inspection, the operation still has the 6% reject rate reported in the spring of 1982. The radio assembly plant was designed for a production rate of 30,000 units/month but the actual output is generally less than 20,000. A reduction in rework time could significantly improve productivity.

The in-process and final quality control test procedures are highly technical and require sophisticated electronic and audio equipment. The complete final inspection testing of a sample AM/FM/Tape Player requires as many as 75 measurements. See Exhibit A, pages 1-3.

Noise created at the radio test stations does not seem to be critical. All test areas have been completely or partially enclosed so that exposure is primarily limited to the inspection personnel.

The firm's administrative offices are located in Seoul, but the production plant is at Yongin. There were subtle indications that the company needs to improve interdepartmental communications. Separate units such as Engineering, Marketing, and Production seem to operate rather independently.

Action During Current Period

After discussing the quality control test methods with a noise expert in the U. S. and observing the operation, the GIT consultant concluded that the noise problem (although a nuisance) was unlikely to be a health hazard. Actual periods that the tester is subjected to high noise levels are very short. This same testing procedure is used in the U. S. and generally meets OSHA regulations.

The majority of the consultant's time was spent investigating the complicated process of quality control testing. There are several in-process test stations which precede final assembly. Because of the large number of tests required, it appears feasible to set up a computer controlled system to perform a sequence of testing and to analyze the results. Such a system would need to be specifically designed for the operation. The GIT consultant lacked the knowledge and experience in electronics and computer science required to provide recommendations on this matter. General information on quality control practices was provided from the following manuals:

1. Quality Control Handbook, 3rd ed., 1974. Section 38: "Electronics Components," and Section 41: "Assembly Quality Control."
2. Industrial Engineering Handbook, 3rd ed., 1971. Section 8, Chapter 5: "Quality Control."

Future Company Requirements

The GIT consultant will provide additional information to the company on computerized testing equipment needed to conduct the sequence shown on the Q.C. Inspection Sheets.

Observed Results and Company Reaction

The quality control manager at the Yongin plant was highly interested in any assistance in automating the Q.C. testing. The company wants to expand production by about 50% and quality control appears to be a roadblock. However, top management was not well prepared for the visits by the GIT/KCGF staff. This may have been because of a lack of internal coordination rather than lack of interest.

QC INSPECTION SHEET

TAPE SECTION		SPEC			SERIAL NO				REMARKS (TAPE NO)
MAXIMUM OUTPUT	KHZ	MIN	W	L					
				R					
DISTORTION	KHZ	MAX	%	L					
				R					
SEPARATION	KHZ	MIN	dB	L					
				R					
TRACK CROSS-TALK	KHZ	MIN	dB	L					
				R					
TAPE SPEED	KHZ	- ~		HZ					
WOW & FLUTTER	KHZ	MAX		%					
BALANCE	KHZ	MAX		dB					
HUM LEBEL		MAX	mV	L					VR MAX
				R					
FREQUENCY RESPONCE	HZ	±	dB	L/R					
	HZ	±	dB	L/R					
	HZ	±	dB	L/R					
	HZ	±	dB	L/R					
	HZ	±	dB	L/R					
CURREN DRAIN	REW CURRENT MAX			mA					
	REC, NO SIGNAL MAX			mA					
	REF, REC CURRENT MAX			mA					
	PLAY NO SIGNAL MAX			mA					
	NO CLIP DISTORTION MAX			mA					
	MAX OUTPUT MAX			mA					
S/N RATIO	HZ	MIN		dB					
ERASING RATIO	HZ	MIN		dB					
VOLTAGE	LOW	MIN		80 %					
	HIGH	MAX		120 %					

MODEL		TEMPERATURE	
LOT NO		TEST BY	
WEATHER			
HUMIDITY			

NOTE

SAM JUNG ELECTRONICS IND,CO.,LTD

QC INSPECTION SHEET

Sam Jung Elec. Ind. Co.
Exhibit A, Page 2

AM SECTION		SPEC	SERIAL NO				REMARKS
EQUENCY RANGE	535 — 1605 KHZ						
FERANCE OUT PUT		W					
F FREQUENCY	455 ± 5 KHZ						
XIMUM SENSITIVITY	600 KHZ	MAX dB					
	1000 KHZ	MAX dB					
	1400 KHZ	MAX dB					
SABLE SENSITIVITY	600 KHZ	MAX dB					S/N 20 dB
	1000 KHZ	MAX dB					
	1400 KHZ	MAX dB					
ALIBRATION ERROR	600 KHZ	MAX dB					
	1400 KHZ	MAX dB					
/N RATIO	1000 KHZ	MIN dB					INPUT 60 dB
MAGE REJECTION RATIO	1400 KHZ	MIN dB					
F REJECTION	600 KHZ	MIN dB					
T.H DISTORTION	MOD 30 %	MAX %					INPUT 60 dB
	MOD 80 %	MAX %					INPUT 100 dB
SELECTIVITY ± 10KHZ	1000 KHZ	± dB					MAX, SENSITIVITY
BANDWITH -6dB	1000 KHZ	± dB					
MAX OUTPUT POWER	1000 KHZ	MIN W					INPUT 74 dB
10% OUTPUT POWER	1000 KHZ	MIN W					INPUT 74 dB
WHISTLE MODULATION	2.IF	MAX %					MOD 30 %
	3.IF	MAX %					INPUT 74dB
AGC FORM	1000 KHZ	MIN dB					MOD 30% INPUT 100dB
AGC DISTORTION	1000 KHZ	MAX %					MOD 80% INPUT 100dB
ELECTRIC FIDELITY	LOW	MAX HZ					1000 KHZ 0 dB INPUT 74dB -6 dB down
	HIGH	MAX HZ					
CURRENT DRAIN	1000 KHZ	A					INPUT 74 dB
L/R BALANCE	1000 KHZ	MAX dB					INPUT 74 dB

MODEL		TEST DATE	
LOT NO		TEST BY	
WEATHER		LOAD IMPEDANCE	
HUMIDITY	%	STD SOURCE VOLTAGE	
TEMPERATURE	°C		

NOTE

QC INSPECTION SHEET

FM SECTION		SPEC		SERIAL NO				REMARKS
REQUENCY RANGE	— MHZ			—	—	—	—	INPUT 60 dB
I F	10.7 ± MHZ							
AXIMUM SENSITIVITY	90 MHZ	MAX	dB					
	98 MHZ	MAX	dB					
	106 MHZ	MAX	dB					
SABLE SENSITIVITY	90 MHZ	MAX	dB					S/N 30 dB
	98 MHZ	MAX	dB					
	106 MHZ	MAX	dB					
IAL CALIBRATION ERROR	MHZ	KHZ						
	MHZ	KHZ						
	MHZ	KHZ						
/N RATIO	L/R	MIN	dB					98 MHZ INPUT 60 dB
MAGE REJECTION	106 MHZ	MIN	dB					2 IF
F REJECTION	90 MHZ	MIN	dB					
PURIOUS REJECTION	90 MHZ	MIN	dB					± ½ IF
	106 MHZ	MIN	dB					± ½ IF
FC HOLDING RANGE	98 MHZ	±	KHZ					INPUT 60 dB OUTPUT-3dB
FC DISTORTION	98 MHZ	MAX	%					INPUT 60 dB PEVIATION 75KC
ULL LIMITING	98 MHZ	MAX	dB					INPUT 60 dB OUTPUT-3dB
UDIO THD 75%	98 MHZ	MAX	%					INPUT 60 dB
UDIO THD 22.5%	98 MHZ	MAX	%					INPUT 60 dB
0% THD OUTPUT	L/R		W	/	/	/	/	98 MHZ INPUT 60 dB
UT PUT POWER AT NO CLIP	98 MHZ	MIN	W					INPUT 60 dB
URRENT MAX	98 MHZ	MAX	A					INPUT 60 dB
ONE EFFECT	98 MHZ	MIN	dB					

MPX SECTION	CARRIER FREQUENCY: 98MHZ	DEVIATION: 75KHZ		PILOT: 10%				
EPERATION	L/R	MIN	dB	/	/	/	/	1 KHZ INPUT 60 dB
ISTORTION	L/R	MAX	%	/	/	/	/	1 KHZ INPUT 60 dB
EACON SENSITIVITY	1 KHZ	MAX	dB					MOD 30%
HANEL BALANCE		MAX	%					R.L OUTPUT RATIO

BUK DOO EUMHYANG COMPANY, LTD.
(Company O)

Dates Visited: March 2 and March 16, 1983

KCGF Staff Involved: Mr. Seon, Yong-Hoon

Principal Products: Speaker Systems

Previously Observed Problems or Questions

At the previous visit by a GIT consultant in the spring of 1982, the following four priority problem areas were selected for research and assistance:

(1) Improvements in Inventory Control methods

(2) Potential use of a small computer to assist in inventory control and production scheduling

(3) Information on paper speaker cone technology

(4) Adhesive technology applicable to speaker system assembly

Problems (3) and (4) were addressed during the visits by the GIT consultant this quarter. Problems (1) and (2) will be handled by the next visiting GIT consultant.

Observed Problems or Questions During the Current Period

This firm purchases most of the speaker system parts and serves primarily as an assembly operation. All cone speakers are presently purchased from RDM or LCC, but the company is interested in manufacturing its own high quality speakers. The manufacturing facility was relocated during the current quarter from Bucheon to new facilities at Dongducheon about 20 miles north of Seoul. At the new complex space has been allocated for the production of various speaker system parts. The company would consider licensing a cone manufacturing process or entering a joint venture. The manager specifically requested information on Holly Speakers (U.S.A.) and would like information on the Audio-Engineering Society.

The company has several assembly problems related to adhesive technology. Specifically mentioned was a need to an adhesive to fasten a rubber gasket to a Mylar cone in one step. They now use a two-step system with chloroprene and a primer. Poor adhesion causes a 20% reject rate. Information was also needed on high-temperature adhesives for use near the voice coil wire.

Action During Current Period

Copies of the following technical articles and publications were proded for the company:

1. Loctite Corporation Audio Speaker Seminar, Application Development Report #12, Butch Marino, September 20, 1979.
2. "Core-stiffening Struts Boost Speaker Performance," E. J. Stefanides, Design News, November 2, 1981. pp. 158-160.
3. "Design Problems of High-Level Cone Loudspeakers," John Gilliom, et al, Journal of the Audio Engineering Society, Vol. 25, No. 3, May 1977. pp. 294-9.
4. "Polymer-Graphite Composite Loudspeaker Diaphragm," T. Tsukagoshi and others, Journal of the Audio Engineering Society, Vol. 29, No. 10, October 1981. pp. 720-5.
5. "Acrylic System Used by Stereo Speaker," Adhesive Age, April 1980. pp. 36-7.
6. "Production Testing of Loudspeakers Using Digital Techniques," L. R. Fincham, Journal of the Audio Engineering Society, Vol. 27, No. 12, December 1979. pp. 970-7.
7. "Plastic Film Boosts Speaker Performance," Machine Design, Vol. 53, September 24, 1981. p. 46.

The GIT consultant discussed with company management the trends toward the use of graphite and plastic cone materials. The special Loctite Report (#1 item above) provided an in-depth evaluation of adhesives used in speaker system construction. The field engineer recommended ethyl-cyanoacrylate (Loctite 414, 420, or 495) for bonding the rubber gasket to a Mylar film cone.

Company management and the GIT consultant discussed approaches for acquiring information in the highly secretive cone technology field. Licensing of a process was encouraged as a means of entering the high quality market.

Future Company Requirements

Upon returning to the United States, the GIT consultant will send the company information on (1) Holly Speakers and (2) the Audio Engineering Society.

Observed Results and Company Reactions

This company is very progressive and appears to be well managed. The staff was particularly appreciative of the assistance provided in adhesive applications. (Korean firms often have difficulty in obtaining technical data from U. S. suppliers.) This firm has great growth potential with its new facilities.

MANAGEMENT AND TECHNICAL ASSISTANCE PROGRAM TO KOREA CREDIT GUARANTEE FUND'S LOAN AND LEASE GUARANTEE COMPANIES

Fifth Year, Fourth Quarter Report

covering the period

May-July, 1983

submitted

July, 1983

Technology Applications Laboratory
Engineering Experiment Stataion
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332, U.S.A.

INTRODUCTION

This report covers the fourth quarter of the fifth year of the Management and Technical Assistance Program for the Korea Credit Guarantee Fund (KCGF) project and provides information on two field engineering visits in Korea for the periods April 1 to May 5, 1983 and May 14 to June 17, 1983. During this time a total of 34 visits were made to twelve companies by Dr. James Bannerman and by Mr. James Muller, respectively. Sixteen of these visits were made to six companies during Dr. Bannerman's field trip, and eighteen visits were made to six companies during Mr. Muller's field trip. The purpose of these visits was a continuation of efforts by the Georgia Institute of Technology (GIT) to provide information and assistance on company problems previously identified as well as to handle any new requests for assistance or information within the constraints of available time.

The procedures previously established by KCGF and GIT of assigning priorities to each company's problems was continued. This procedure has improved the efficiency with which field assistance has been delivered. It has also enabled GIT to focus research activities, with a resulting improvement in the technical assistance process.

The KCGF Staff continued to do an excellent job in scheduling company visits and providing necessary support for the GIT Field Engineers. GIT personnel were well received at the companies they visited.

Extensive research activities at GIT were conducted in order to support the two field engineers. This research was done usually prior to the in-country visit by the field engineer. However, in other instances it was performed by GIT researchers at the cabled or telephoned requests of the field engineers. The results were then air-mailed or telexed for immediate application to information needs or problems.

The following field reports, contained in two separate sections, provide a summary of the technical assistance activities provided to twelve companies. Draft copies of each of the field engineers' summary reports were presented to KCGF prior to their departures from Korea.

MANAGEMENT AND TECHNICAL ASSISTANCE PROGRAM TO KOREA CREDIT GUARANTEE FUND'S LOAN AND LEASE GUARANTEE COMPANIES

by

James W. Bannerman P.E.
Southern Technical Institute

This report covers the five weeks field engineering work from April 1, 1983 to May 5, 1983

Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332, U.S.A.

PREFACE

This report documents the five week field engineering work performed for the Korean Credit Guarentee Fund by Dr. James W. Bannerman as a representative of the Georgia Institute of Technology. The period covered is from April 1, 1983 thru May 5, 1983.

Initially seven companies were assigned to the consultant however, prior to his arrival in Korea, one of the companies, Tae Chang Industrial Co. Ltd., went into bankruptcy and ceased to operate.

The report is formated as follows:

I Summary Report

II Buk-Doo Eumhyang Co. Ltd.

III Rolens Watch Co.

IV Yu Il Corporation

V Dong Kwang Co. Ltd.

VI Sam Shin Iron Ind. Co. Ltd.

VII Sam Jung Electric Ind. Co. Ltd.

SUMMARY REPORT

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E.

COMPANY NAME --- Product or Service	VISIT DATES --- KCGF Staff	Previously Observed Problems or Questions	Problems Observed & Questions Current Visit	Actions During Current Visit	Future Company Requirements	Observed Results & Company Reaction
Sam Jung Electric Ind. Co. Ltd. --- Automobile Radios and Stereo Equipment	April 12, 1983 April 19, 1983 --- Mr. Snin Jung-Sup	1. Noise problem caused by Q.C. testing at high volume. 2. Need information on Q.C. procedures for auto radios 3. Need information on product development organizational structure.	4. Problems 1 & 2 were assigned to the previous GIT consultant. 5. The client stated that the company management had changed and that they did not perceive a problem in the area of organizational structure as previously reported as problem 3. However, since the consultant had performed the research they would like a briefing on a suggested organizational structure.	1. The consultant prepared and presented a paper on the matrix organizational structure with particular emphasis on how it could be applied to the product development activity at Sam Jung Electric Co. Ltd. 2. Provided copies of the following documents relating to matrix organization structure: *Argyris, C. "Todays Problems with Tomorrow's Organizations"; Journal of Management Studios, Feb. 1967 *Davis, S.M. "Problems of Matrix Organizations"; Harvard Business Review, May-June 1978 *Galbraith, J.R. "Matix Organizations Design"; Business Horizons, Feb. 1971 *Gibson, J.L. Organizations, Business Publications, Inc. Plano, Texas 1982 (Chapt. 11, "The Anatomy of Organizations") *Knight, K. "Matrix Organizations: A Review"; The Journal of Management Studios, May 1976 *Sisk, H.L. Management & Organizations, South-Western Publishing Co. Cincinnati, Ohio 1981 (Chapt. 9, "The Structural Design of Organizations")	The company representative stated that they had no problems or questions which required consultant assistance. No future actions are anticipated.	The company representatives were receptive and seemed to be interested in the new management concept proposed by the consultant. Since, however, they do not have a problem there is some doubt that the suggestions will be implemented. They promised deliver the material to the superiors for consideration

SUMMARY REPORT

KCGF/GIT Project — April 1, 1983 thru May 5, 1983 — James W. Bannerman P.E.

COMPANY NAME / Product or Service	DATES VISITED / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed on Current Visit	Actions Taken During Current Period	Future Actions Required	Observed Results & Reactions
Bukdoo Eurhyang Co. Car Radio Speakers	April 6, 1983 April 18, 1983 April 25, 1983 April 29, 1983 Mr. Shin Jung-Sup	1. Inadequate space for raw materials storage. 2. Need information about computerization of Inventory and Production Management functions. 3. Paper cone technology (assigned to another consultant)	4. Production line not properly balanced - results in non-productive labor. Company wants instruction on methods of production line balancing. 5. Several work stations poorly laid out and in violation of the principles of motion economy. Company wants instruction in methods of work station design.	1. Consultant wrote and presented a paper concerning the A-B-C method of inventory control as it would apply to the Bukdoo Co. Made recommendations for implementing a manual inventory management system which could be adapted to a micro-computer at a future date. Assisted the company in implementing the recommended system. 2. Consultant wrote and presented a paper summarizing the 22 principles of motion economy. Also designed and presented a proposed work station layout for one of the assembly line operations. Using these documents instructed the client in the technology of methods and work station engineering. 3. Demonstrated the methods of balancing a production line by actually balancing one of the current assembly lines. Reduced the number of required workers from 30 to 24 with no decrease in production. Wrote a memo describing significant points in the line balance effort and recommending client follow-up.	All the identified problems and questions were resolved. The company has indicated an intention to implement all three recommendations. There are other areas for productivity improvement at Bukdoo but they should be delayed until the current efforts are assimilated. As the current recommendations are implemented some technical assistance may be required.	The company Production Engineer and President were most appreciative of the research conducted by the consultant. They indicated that they planned to implement each of the suggestions. Evidence of their intentions was observed during the last visit ie: 1. The work station design submitted by the consultant had been built and was being used with a noticeable increase in efficiency. 2. The "help wanted" sign at the company gate was removed in anticipation of increased productivity with existing employees thru methods engineering.

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E.

Company Name / Product or Service	VISIT DATES / KCGF Staff	Previously Observed Problems or Questions	Observed Problems or Questions Current Visit	Actions During Current Period	Future Company Requirements	Observed Results and Company Reactions
Rolens Watch Co. (Olympic C) Clocks and Wall Clocks (Both electric and spring operated)	April 5, 1983 April 14, 1983 Mr. Shin Jung-Sup	1. Need information on how to reduce the cost of the stator in the electric clock motor. Current material is 25% Ni and 75% Fe and cost about 300 Won (45¢) each. Almost 1/2 the price of the clock motor is in the stator.	2. Production line is inefficient due to lack of methods engineering and work place design. 3. Lack of automation. Almost all operations are performed by hand or with hand powered tools.	1. Provided a sample of material used in clock motors by Westclock Co. in U.S. Material is C1005 cold rolled steel with Rockwell "B" less than 55. Cost is about 1/10 of the price of the current material. 2. Provided names and addresses of steel manufacturer, metalurgist and ordering information. 3. Wrote a letter to Worthington Steel asking for a sample large enough for Rolens to run tests to be shipped directly to Rolens. 4. Made several suggestions pertaining to methods engineering and work place design for the company's production facility.	The CIT consultant provided his U.S. address and offered assistance in obtaining sample stator material for testing or in placing an order.	Client was extremely pleased with the prospect of obtaining a less expensive material for his clock motor stators. They will run tests when the sample arrives and if the material proves acceptable will probably change to the new material. Client was very appreciative of the consulting suggestions concerning productivity improvement but will probably not implement them at this time due to worker resistance.

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E

Company Name / Engineering Service	Visit Dates / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed Current Visit	Actions During Current Visit	Future Actions & Requirements	Observed Results and Company Reaction
Steel Corp Metal office furniture	April 11, 1983 April 28, 1983 Mr. Seon Mr. Shin	1. Problems with spot welding: a) The company wants to weld at longer reaches. Need information on welding equipment or modifications to existing equipment which will allow it. b) Current welding procedures produce dimples and surface blemishes. Need a welding schedule which will eliminate the defect. 2. Need information on automatic painting systems. 3. Need assistance in efficient plant layout and materials handling.	4. There is inadequate space to store finished inventory prior to shipment. Overflow is currently stored in aisles and in production area.	1. Provided information and equipment brochures describing modern resistance welding equipment - specifically equipment with long reach capability. 2. Provided a list of publications and ordering information for materials produced by the Resistance Welder Manufacturers Association. 3. Provided copies of the portion of the 1982 Thomas Register pertaining to resistance welding equipment. 4. Described the electrostatic spray painting process and provided brochures and equipment descriptions for the Ransburg Electrostatic Spray Painting System. 5. Provided a copy and discussed Chapter 6 "Conventional Techniques for Analyzing Material Flow" from Plant Layout and Materials Handling by James Apple. 6. Provided a copy of the section of the Metals Handbook pertaining to Resistance Welding. Went over the material page by page and emphasized the reason and methods of prevention of spot weld dimples. Emphasized the absolute necessity for a systematic investigation of various combinations of squeeze pressure, electrode characteristics and welding current to identify the best combination. Outlined a test procedure and made specific recommendations for the establishment of a welding schedule.	None.	The company representative was quite receptive and very appreciative of the research conducted and documentation provided by the consultant. It appeared, however, that the company will be somewhat reluctant to implement the suggestions. The electrostatic painting system may be too expensive; they are not sure (after consideration) that they need to weld at longer reaches; and they feel that a systematic investigation of the dimpling problem may be beyond their technical capability. They probably will make some effort to improve materials flow and storage layout using the procedures described by the consultant.

SUMMARY REPORT

KCGF/GIT Project — April 1, 1983 thru May 5, 1983 — James W. Bannerman P.E.

Company Name / Product or Service	Visit Dates / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed Current Visit	Actions During Current Visit	Future Actions & Requirements	Observed Results & Company Reactions
Ding Kwang Co. Ltd. Cloth & Plastic Cases	April 7, 1983 April 15, 1983 April 21, 1983 Mr. Shin Jung-Sup	1. Need information about equipment to install zipper stops. 2. Need information about technology of sewing long seams so that ends come out even. 3. Need information about modern sewing machines, accessories and materials 4. Need assistance in efficient sewing layout.	5. Need a large shear to cut up to 50 ply of P.V.C. up 150 cm (59") wide. 6. Need ability to establish "standard time" for each product so that the company can do production scheduling and forecasting.	1. Provided information and brochures from several U.S. companies who manufacture and/or distribute zipper bottom stop machines 2. Provided operating instructions, cost information, and ordering instructions for both new and used zipper bottom stop machines 3. Provided a copy of the 1982 edition of the SANBRAND catalog #231 - A complete line of cutting, sewing, finishing, and warehousing equipment, parts, and accessories 4. Provided information, catalogues, and brochures from a number of U.S. and international distributors of modern sewing machines and accessories 5. Analyzed the company's sewing machine requirements (in light of problems 1 & 2) and made specific recommendations for the acquisition of new equipment 6. Provided instruction to company personnel on methods of analyzing (Assembly chart, flow process chart, flow diagram) and implementing efficient plant layout and materials handling systems 7. Provided instruction in methods of establishing "standard times" and using that information to implement production control and scheduling 8. Provided the following documentation to support the instruction cited in 5 & 6 above: A. Apple, J.M. Plant Layout and Materials Handling, John Wiley & Sons, New York 1977. (Chapter 5 "Conventional Techniques for Analyzing Material Flow", and Chapter 11 "Space Determination") B. Sewing Room Production Systems, an unpublished paper by Kurt Salmon Associates Inc.	1. Consultant will, upon return to U.S., research and forward to the client through KCGF, information on large material shears 2. Consultant will upon return to U.S., research the availability of a pre-needle belt cutting attachment which the client claims to have seen on a machine in Taiwan	1. The client was extremely pleased with the documentation concerning new sewing machine equipment and accessories. He indicated that he planned to follow the consultant's recommendations for machine replacement 2. The client was very receptive and appreciative of the instruction provided concerning plant layout, setting time standards, and establishing production control and scheduling. Although some of the techniques may be beyond the technical competence of the plant personnel, they are now aware of the need for these techniques. The client indicated that he may hire a private consultant to implement the system recommended by the consultant

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E.

Company Name / Product or Service	Visit Dates / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed on Current Visit	Actions During Current Visit	Future Actions & Company Requirements	Observed Results and Company Reactions
Sam Shin Iron Ind. Co. Ltd. / Forged Steel Valves & Fittings	April 4, 1983 April 26, 1983 April 29, 1983 / Mr. Shin Jung-Sup	1. Want to purchase books on high pressure valve design and manufacture. Need a listing of current titles 2. Want to manufacture ASME "N" stamped valves. Need information on how to obtain ASME nuclear certification 3. Want to upgrade their machining operations by the acquisition of numerical control (NC) machines. Want information about currently available NC machines 4. Want current information on forging technology, need articles and titles of books on the subject	5. Quality Control supervisor reports that they are using an excessive amount of company resources to comply with MIL STD 105D Q.C. specifications. Need consultant to review their Q.C. procedures and make recommendations for reducing Q.C. effort but maintaining some Q.C. level 6. Company Q.C. department has a Rockwell hardness tester, but no calibration standards Need a certified calibration standard	1. Provided a Xerox copy of the title page, table of contents, and preface of six books on valve technology. A) Handbook of Values (P. A. Schweiter, 1972) B) Lyons Encyclopedia of Values (J. L. Lyons, 1975) C) Valve Design (G. H. Pearson, 1972) D) ISA Handbook of Control Values (J. W. Hutchinson, 1976) E) Lyons Valve Designers Handbook (J. L. Lyons, 1982) F) Valve Selection Handbook (R. W. Zuppe, 1981) 2. Provided copies of articles from two recent technical publications 3. Provided copies of the appropriate pages (relative to valve technology) from both the 1980 and 1981 editions of the Applied Science and Technology Index 4. Provided an application form and numerous documents describing the procedure for obtaining an ASME "N" stamp certification. 5. Provided a copy of the Q.C. portion of Section III of the ASME Boiler and Pressure Vessel Code 6. Provided the name, address, and phone number of a contact within ASME for further information about "N" stamp certification 7. Provided the name and contact information of a U.S. company that will assist (for a fee) in obtaining "N" stamp certification 8. Provided a list of companies authorized as independent witnesses for Nuclear Q.C. inspections 9. Recommended that because of the cost and procedural difficulties involved Sam Shin Iron Ind. should consider subcontracting to another company who already has ASME certification rather than attempting to obtain their own certification	1. The consultant will obtain membership information for the American Society for Quality Control (ASQC) and forward to the client through KCGF 2. The company will investigate the possibility of subcontracting to a firm which already has the ASME "N" stamp certification	1. The company representative was very appreciative of documentation provided and was enthusiastic about many of the consultant's recommendations; specifically those concerning the ASME "N" stamp certification and the Quality Control procedures 2. The company's production facility is already quite modern by Korean standards, and they are interested in acquiring NC machinery; however the cost of acquisition may be prohibitive at this time. The company representative was anxious, however, to review the documentation and analysis that the consultant provided

BUK-DOO EUMHYANG CO. LTD.

BUKDOO EUMHYANG CO., LTD.

(Company O)

Dates Visited: April 6, April 18, April 25 and April 29, 1983

KCGF Staff Involved: Mr. Shin Jung-Sup

Primary Product: Radio Speakers

Company Background:

The Bukdoo Eumhyang Company is a manufacturer of car radio speakers. The company produces over 100 sizes and styles of speakers in its plant outside Seoul which employs approximately 350 workers. Gross sales in 1982 exceeded $5 million with 75% directed overseas to Europe and the U.S., and the remaining 25% used by secondary markets within Southeast Asia.

Previously Observed Problems and Questions:

During the preliminary visit by a GIT field engineer the company identified four problems with which they desired assistance. In a subsequent agreement between GIT consultants (see attached memo) the last two problems, dealing with cone-paper technology were assigned to another consultant. The two problems assigned to the current consultant were:

1. The storage facility for raw materials is inadequate and poorly arranged. The company needs assistance with storage layout and inventory management.
2. The company management is interested in using a micro computer (Radio Shack TRS-80) for inventory and production management. They need information about the capability, limitation and cost of such equipment and software.

Problems and Questions Observed During Current Visit:

3. A tour of the production facility revealed that the assembly line was considerably out of balance with a significant number of idle workers. The company representative requested instruction in the methods of balancing production lines.

4. The layout of many of the work stations violated the principles of motion economy. The company representative requested suggestions and improved work place design.

Actions Taken During Current Visit:

During the first visit on April 6, 1983 the consultant met with client representatives and toured the production facility. A subsequent discussion revealed that the previously reported problem with inventory storage space had been solved by a recent move to a new and larger factory. The client stated also that they were not ready to consider computerization of the production and inventory management systems at this time but were very interested in taking initial steps to prepare their inventory management system for eventual computerization. They wanted a system which can be operated manually at the present time and easily adapted to a micro-computer in the future. The consultant promised to research the problem and prepare a set of recommendations for the next visit.

During the tour of the production facility the consultant pointed out several work places that were poorly designed from the standpoint of motion economy. The client requested instruction and assistance in redesigning the work places. The consultant pointed out that he could redesign the work

station, however when the production line changed for the next model run the designs would be obsolete. It would be more beneficial if the client learned the techniques of efficient workplace design. To that end the consultant promised to prepare a set of documents describing the principles of motion economy and the techniques of work place design. These documents were to be presented during a subsequent visit.

During the second visit on April 18, 1983, the consultant presented a paper he had written specifically for Bukdoo on Inventory Management Considerations (a copy of that paper is attached to this report). The client was asked to read the paper and gather the data (described therein) necessary to implement the system. The consultant agreed to answer any questions concerning the paper and assist in implementing the system on subsequent visits.

The consultant also provided information and brochures describing the TRS-80 micro computer and its inventory management software package. The system was discussed and the advantages and disadvantages to Bukdoo were pointed out.

During the third visit on April 25, 1983 the client presented his data for the inventory management system. He stated that he had read and understood the consultant's paper and was prepared to implement the A-B-C method of inventory control. The consultant clarified a few technical points and the client stated that he could proceed without further assistance.

The consultant next presented a paper on summarizing 22 principles of motion economy and a redesign of one of the work places (copies attached). Each of the principles and their application were discussed at some length, after which the client indicated that he understood the technique and would attempt to redesign some of the more inefficient work places.

During the fourth visit on April 29, 1983 the consultant instructed the client in the techniques of production line balancing. The plant engineer and the consultant then balanced the existing line as an example of how the techniques should be applied. Attached to this report is a memo to Bukdoo presenting notes and the results of the line balancing effort. In effect the number of workers on the single line analyzed was reduced from 30 to 24 without decreasing production. Both the plant engineering manager and the company president were impressed with the results and indicated that in the future, when possible, production lines would be balanced as part of the start up procedure.

Future Company Requirements:

All of the company's reported problems and questions were answered. All that remains is for the company to implement the consultant's recommendations. There are numerous other areas for productivity improvement at Bukdoo but efforts on them should be delayed until the current recommended improvements have been assimilated.

Observed Results and Company Reactions:

The company representatives were extremely appreciative of the consultant's efforts. Without doubt most of his recommendations will be implemented. Several recommendations have already been implemented; for example during the last visit it was observed that the work station design prepared by the consultant on the previous visit had been constructed and was being used with considerable improvement in efficiency. It was also observed that a "Help Wanted" sign on the company gate was immediately removed after the company president saw the results of the line balancing effort. It is obvious that the company management

was enthusiastic and confident in the potential manpower saving that could be achieved through proper methods analysis and design.

To: Bukdoo Eumhyang Co. Ltd.

From: James W. Bannerman P.E.

Subject: Notes on balancing the production line for the 3 inch - 8 ohm-1 watt standard speaker.

I. Analysis of the Current Line:

Current production is at the rate of approximately 800 speakers per hour employing thirty production line employees (not counting supervisors). The pacing activity is "riveting the terminal to the rear of the speaker frame." (activity #1) This is the first activity on the line and loads the line for subsequent activities. That activity requires 3.3 seconds per speaker, and even with appropriate allowance for fatigue, should produce approximately 1000 speakers per hour. The lower actual production rate can be attributed to production line inefficiencies and short duration, but frequent, power outages. There appeared to be no stoppage due to materials shortage, although it was noted that the workers at several critical stations had to replenish their own materials stock.

II. The Proposed Line:

Data was gathered and a proposed line balance developed as shown on the attached data sheet. Under the proposed line, production will still be set at 1000 units per hour, however, the number of workers is reduced from 30 to 24. If it is desired to increase production a new parallel line will be required since the current line and the proposed line are both paced by fixed machine operations (activity 1 and 2).

All of the "combined" activities shown on the proposed line may not be possible and therefore the proposed line might have to be modified to some extent. The proposal does provide a starting point however, and identifies areas for improved productivity thru innovative design. Specifically, the following should be noted: (activities described on attached worksheet)

a) Activities 2 and 3 may be difficult for one person to perform efficiently. It might be better to delay activity 4 until just prior to and in combination with activity 9.

b) Activities 6, 7, and 8 all require glue gun operations. Activities 6 and 8 use a different kind of glue than

activity 7. It is suggested that these activities might be combined (to be done by 2 people instead of 3) by using a double-barreled glue gun.

c) Activities 16 and 17 probably cannot both be done by a single worker. It may be possible, however, for one worker to perform activity 16 for both sides of the production line and another worker to perform activity 17 for both sides. This will reduce the total number of people required for these operations on both lines from 4 to 2 saving one person on each line.

III. Future Actions Recommended:

The Bukdoo Engineering manager should continue the analysis started on this visit. When an acceptable balance has been achieved, the sequence and duties at each station should be well documented and filed. The next time that particular model speaker is produced, the production line plan can be retrieved and implemented immediately. Similar line balancing efforts on the other Bukdoo speaker production lines will make major improvements in the company's productivity. It must be remembered, however, that a production line, once balanced, should not be considered fixed. The engineer must always be alert for methods of improving the balance thru improved work methods, work place design or mechanization.

James W. Bannerman P.E.
G.I.T. Consultant to K.C.G.F.

4/29/83

cc: K.C.G.F.

Bukdoo Eumhyang Co. Ltd.

Assembly Line Balance – 3 inch 8Ω 1W Standard Speaker

4/29/83

Activity Number	Preceding Activity	Description of Activity	# Workers Assigned	Seconds Per unit	Proposed # Assigned	Sec. Per unit
1	—	Rivet Terminal to Frame	1	3.3	1	3.3
2	1	Weld Magnet to Frame	1	2.7	1	2.7
3	2	Clean Air Gap	1	1.6	1	2.8
4	3	Glue Terminal to Frame	1	1.2		
5	2	Insert Coil & Dampner	2	6.0	2	3.0
6	5	Glue Dampner to Frame	1	2.1	2	3.2
7	6	Insert & Glue Cone to Frame	1	2.1		
8	7	Insert & Glue Gasket	1	2.3		
9	8	Seat Gasket & load Aging Tray	1	2.0	1	2.0
10	9	Load Belt from Aging Tray	1	1.0	1	3.0
11	10	Punch Terminal wire holes	1	2.0		
12	11	Insert Terminal wire	3	8.7	3	2.6
13	12	Solder Coil to terminal wire	3	6.4	2	3.2
14	13	Solder Terminal wire to Terminal	2	6.0	2	3.0
15	14	Trim wires & Remove Coil Core	1	2.8	1	2.8
16	15	Glue Coil/Terminal wire	2	4.0	2	3.0
17	16	Glue & Insert Dust Cap	1	2.0		
18	15	Glue back of Terminal wire	1	3.1	1	3.1
19	All	Inspect & load on Aging Rat	1	DW	1	DW
20	19	Load belt & Magnitize	1	1.5	1	3.4
21	20	STAMP lable	1	1.9		
22	20	QC Frequency response	1	DW	1	1
23	All	Pack for shipment	1	DW	1	1
		Total Worker Req.	30		24	

J. W. Bannerman P.E
GIT Consultant to KCGF

INVENTORY MANAGEMENT CONSIDERATIONS

A Paper Written for the

BUKDOO EUMHYANG CO., LTD.

by

James W. Bannerman, P. E.

consultant to the

KOREAN CREDIT GUARANTEE FUND

Seoul, Korea

April 7, 1983

The Nature of Inventory Management

An inventory control system may be very simple, or quite elaborate or anywhere in between. In each case, however, the system is essentially a set of rules which describe when to order items for inventory, and how many items to order.

The complexity of the inventory management system is generally in direct proportion to the value of the items maintained in inventory or the cost associated with an inventory shortage. If too large an inventory is maintained, excess capital will be tied up in material sitting on the shelf. If too small an inventory is maintained, the company may experience lost capital through cancelled orders or penalty payments for expedited delivery of needed parts. The purpose of an inventory management system then, is to balance these two potential costs and at the same time de-couple the production process from the parts purchasing process.

Inventory Characteristics

Inventories generally contain large numbers of parts or items. It would not be unusual for a company like BUKDOO EUMHYANG CO. LTD. to maintain an inventory of well over a million individual items, with as many as a thousand different categories. Such a profusion of different items may appear to make the task of establishing an inventory control system beyond the capability of the technical and managerial staff of the company. There are, however, some assumptions and procedures which will simplify the process and at the same time prepare the inventory system for future adaptation to a computer.

The A B C Method of Inventory Control

This method is designed to focus attention on inventory items in proportion to their value and importance. The importance of any item is determined by (1) the value of the item, (2) the time required to replenish depleted stock and (3) the cost of a stock outage.

Generally, a small percentage of the inventory items make up a large percent of the cost of the inventory investment. These items are called class "A" items and special care should be taken in controlling their inventory. By contrast some items are comparatively unimportant. Generally as much as 50% of the inventory items fall into this category. Inventory control of these items which are called class "C" can be quite simple.

All items which are not class "A" or class "C" are in class "B". These items are of average importance and their inventory control should receive a normal amount of attention.

It is this A-B-C method of inventory control which will be described in this paper and recommended to the BUKDOO EUMHYANG CO., LTD.

Establishing The Order Rules

An order rule is a statement of when to replenish inventory, in what quantity to replenish it, and how frequently the inventory should be reviewed to determine which items should be ordered. The objective of the order rule is to establish a balance among (a) the cost of replenishing inventory, (b) the cost of carrying inventory, and (c) the cost of stock outages.

In establishing an inventory management system for the BUKDOO EUMHYANG CO., LTD. it is recommended that three sets of inventory rules be employed: one each for class "A", "B" and "C" items.

The first step then is to classify all items in inventory as A, B, or C. This is the client's responsibility and must be done before any other steps in the inventory management system can be implemented. The company inventory clerk should tabulate the following data on each item carried in inventory.

1. Item name and identification data
2. Cost per unit
3. Normal usage rate
4. Replenishment lead time
5. Shortage cost
6. Re-order cost
7. Quantity discount information
8. Unusual cost of holding inventory
9. Replenishment time for emergency replenishment

The second step will be to classify inventory items as class A, B, or C. This should be done by the company management after reviewing the tabulation described in the previous paragraph.

There are six basic order rules available. One of these rules, or a slight modification, will fit almost any inventory management requirement. The six rules are as follows:

1. Fixed re-order point
2. Net requirements
3. Reservations
4. Fixed review time
5. Group ordering
6. Two-bin order control

Although no definitive recommendation can be made as to which rules should be adopted by BUKDOO EUMHYANG until the A-B-C classification has been completed and the data on individual items reviewed, it is anticipated that the Net Requirements rule, Fixed Re-Order point rule and Two-Bin Order rule will be recommended for class A, B and C items respectively. These three rules are described below to illustrate the type of inventory control procedures that should be practiced. If analysis of the data on specific inventory items indicates that other rules might be more appropriate, they will be recommended with a full explanation of their operation. The rules described below should give the client an understanding of the involvement and commitment which will be necessary if he is to adopt an inventory management system.

Two-Bin Control System Recommended for Class C Items

The Two Bin Order control system is designed to provide control at a minimum cost. It relies on physical or visual control of inventory rather than on formal inventory records. It is particularly suited then to "high volume, low importance" items as identified as Class "C".

The rule operates as follows: one bin contains a quantity equal to the re-order point quantity (determined from the usage rate, re-order lead time, and safety stock). This bin is sealed shut so that all withdrawals are made from a second bin. When the second bin is empty, the seal on the first bin is broken and an order is placed. When the order is received it is placed in a bin and sealed while withdrawals continue to be made from the other bin. The procedure continues with re-order quantities reviewed and re-established periodically.

Fixed Re-Order Point Rule Recommended for Class B Items

The re-order date in the Fixed Re-Order Point rule is determined when the stock on hand plus stock already on order falls to the order point. The order point is an inventory level as large as the reasonable maximum usage of the item during the lead time to replenish stock. How much to order is prescribed by the Economic Order Quantity (EOQ) calculation, which will be explained to the client if this rule is adopted. In any case the Economic Order Quantity is calculated as the quantity that will result in the lowest total cost of ordering, making or procuring the item and carrying the resulting inventory.

Under this rule, the re-order quantity is fixed, and the time interval between orders varies according to usage rate. The quantity on hand is checked every time material is withdrawn, and when the minimum on hand inventory is reached a new order is placed.

This rule is relatively simple (although more complex than the two-bin system) to operate and maintain, because order points and quantities for many items need be revised only infrequently. It is well suited, therefore, to Class B items.

Net Requirement Order Rule Recommended for Class A Items

Under the Net Requirements rule, gross requirements are determined for each item - either from forecasts or from orders already on hand - for each period (such as a month). The gross requirements are then converted to net requirements by subtracting the numbers of unallocated units on hand and

already on order. Orders are placed for the net requirement thereby adjusting for any errors in the forecast for the previous period. Thus inventory is ordered every time requirements are developed, and order quantities vary depending on the net requirement.

The Net Requirements rule demands more clerical effort than the other rules, and therefore should be used only for Class A items where the potential savings in inventory procurement and carrying costs will be offset by the additional clerical costs.

Conclusion

This paper describes in brief outline the procedures and rationale for an elementary inventory management system. It does not contain the details necessary to implement such a system. These details and the technical assistance required will be provided if the client decides to adopt an inventory management system and is able to provide the necessary background data. The system suggested is totally a manual operation, however, it will provide the first step to future computerization.

In conclusion, it should be emphasized that inventory control does not necessarily mean keeping inventories at a minimum, for the lowest possible inventory is often not the best or least costly inventory. The real need is to achieve the best balance between too much inventory with all its financial hazards and too little inventory with all its unfavorable effects, customer relations, competitive position, and production stability. Inventory control in the BUKDOO EUMHYANG CO., LTD. offers tremendous potential if the company is willing or able to commit the resources necessary for its implementation and maintenance.

Acknowledgements

Much of the information contained in this paper was taken directly from the Industrial Engineering Handbook, by H. B. Maynard. (Specifically Chapter 4 by Roy L. Allen). Since credits are not shown for direct quotes this paper should not be published or reproduced. It is intended for the specific use of the BUKDOO EUMHYANG CO., LTD. under the sponsorship of The KOREAN CREDIT GUARANTEE FUND.

James W. Bannerman P.E.

Consultant, Korean Credit Guarantee Fund

A SUMMARY OF THE 22 PRINCIPLES OF MOTION ECONOMY

Prepared for

BUKDOO EUMHYANG CO., LTD.

by

James W. Bannerman
GIT Consultant to KCGF

Seoul, Korea
April 1983

The Principles of Motion Economy

The 22 principles of motion economy as related to the use of the human body were developed by Frank and Lillian Gilbreth, the founders of industrial engineering, in 1923. Since that time they have been interpreted, investigated and proved but they remain today just as valid as they were 60 years ago. Many of these rules can be applied directly to the production operations at The Bukdoo Co. with a resultant improvement in productivity.

The twenty-two rules are stated in this paper along with a brief explanation or amplification where appropriate. Each station on the production line might be examined in the light of these rules. Maximum benefit will be derived, however, from applying the rules to these activities which are machine coupled: for example, the operation where the washer is welded to the rear of the speaker frame. These rules will also provide a valuable guide when designing future work stations or incorporating jigs and fixtures.

1. The two hands should begin and complete their motions at the same time.
2. The two hands should not be idle at the same time except during rest periods.
3. Motions of the arms should be made in opposite and symmetrical directions and should be made simultaneously.

The first three principles are closely related. The hands should work together stopping and starting at the same time and in symmetrical but opposite directions. It is frequently very easy to arrange the work place or build a fixture which will take advantage of these three rules.

4. Hand and body motions should be confined to the lowest classification which is possible to perform the work satisfactorily. The motions in order are:
    a. Finger motions
    b. Finger and write motion
    c. Finger, wrist and forearm motion
    d. Finger, wrist, forearm and upper arm motion
    e. Finger, wrist, forearm, upper arm and shoulder motion.
5. Momentum should be employed to assist the worker whenever possible, and it should be reduced to a minimum if it must be overcome by muscular force.

Where possible use the momentum to do the work like driving a nail rather than screwing. Avoid using muscles to overcome momentum and stop the piece.

6. Smooth continuous curved motions of the hands are preferable to straight line motions involving sudden and sharp changes in direction.
7. Ballistic movements are faster, easier and more accurate than restricted (fixation) or controlled movements.

A ballistic movement employs energy only at the beginning of the stroke as in using a hammer. The controlled movement uses energy during the entire stroke such as bringing a pencil to the pad in preparation to write.

8. Work should be arranged to permit an easy and natural rhythm whenever possible.

Rhythm is important. It is a pacing mechanism and results in less fatigue than the same work done at irregular intervals.

9. Eye fixations should be as few and as close together as possible.

10. There should be a definite and fixed place for all tools and materials.

The operator should always be able to find the tools and materials in the same place. Likewise finished parts should always be delivered to a fixed location.

11. Tools, materials and controls should be located close to the point of use.

12. Gravity feed bins and containers should be used to deliver materials close to the point of use.

13. Drop delivery should be used whenever possible.

The work should be arranged so that the finished units may be disposed of by releasing them in the position in which they are completed.

14. Materials and tools should be located to permit the best sequence of motions.

The material required at the beginning of a cycle should be placed next to the point of release at the finished piece from the preceding cycle.

15. Provisions should be made for proper lighting of the work place.

16. The height of the work place and the chair should preferably be arranged so that alternate sitting and standing at work are easily possible.

17. A chair at the type and height to permit good posture should be provided for every worker.

18. The hands should be relieved of all work that can be done more advantageously by a jig or a fixture or a foot operated device.

19. Two or more tools should be combined when possible.

It is usually quicker to turn a small two ended tool end-for-end than it is to lay one down and pick up another.

20. Tools and materials should be prepositioned whenever possible.

The repository for a tool should facilitate the next grasp of the tool.

21. Where each finger performs some specific movement, such as in typewriting, the load should be distributed in accordance with the inherent strength of the finger.

First and second fingers are stronger than the third and fourth. The right hand is generally stronger than the left.

22. Levers, crossbars and handwheels should be located in such a position that the operator can manipulate them with the least change in body position and with the greatest mechanical advantage.

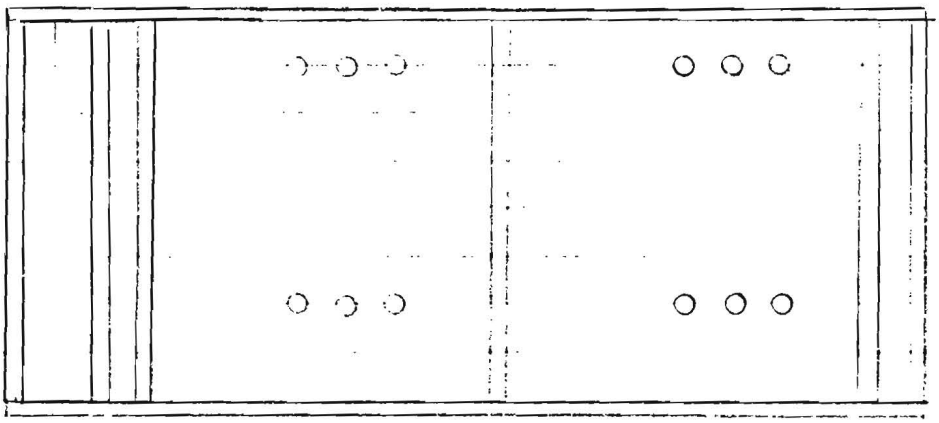
The more convenient a machine is to operate the higher the production is likely to be.

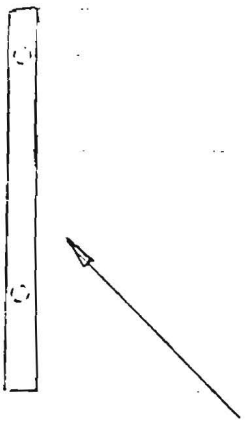
Project No. KCGF

Book No. _____ TITLE BUKDOO EUMHYANG CO. LTD.

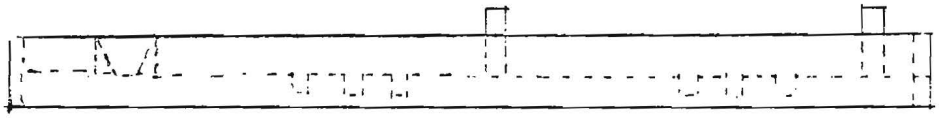
Page No. __

WORK HOLDER FOR SPEAKER FRAME-WASHER WELDING OPERATION





MOVABLE PARTITION
2 REQUIRED.



SPEAKER FRAMES STACK HERE.

FINISHED WORK STACKS HERE.

WASHERS STACK HERE.

NOTE: MULTIPLE WORK HOLDERS CAN BE STACKED IN A CART AND PLACED AT THE WORK STATION.

NOT TO SCALE DIMENSIONS DETERMINED BY SIZE OF SPEAKERS

To Page No. ___

ed & Understood by me.	Date	Invented by James W. Bannerman	Date 4/20/83
		Recorded by	

ROLENS WATCH COMPANY

ROLENS WATCH COMPANY

(Company C)

Dates Visited: April 4 and April 14, 1983

Company Representatives Involved: Mr. Choe Tae, Leon (Manager)
Mr. C. D. Ok (President)

KCGF Staff Involved: Mr. Shin Jung-Sup

Background of Company:

The Rolens Watch Company produces a line of watches and wall clocks, with about fifty different styles of watches and eighty styles of clocks, both electric and wind-up. Approximately 70% of their product is for domestic consumption with the remaining 30% exported to Italy, the Netherlands, and France. The Company was organized in 1975 and currently employs 100 people in its two plants. Gross sales in 1982 were 2 billion won ($3.2 million).

Previously Observed Problems and Questions:

During the survey visit by the GIT field engineer, the company representative related that their primary concern was in reducing the cost of the stator in their electric clock motors. The current material is 25% N: and 75% Fe. It is formed in 2 laminations and costs about 300 won ($.50) per motor. They want to know if the stator can be made of wire or redesigned with less expensive materials.

The GIT field engineer reported no other problems or questions.

Observed Problems and Questions During Current Period:

In addition to the problem previously reported it was observed that the production line was quite inefficient. There were only two power operated machines in the entire plant. The

rest were hand operated, and absolutely no automation was employed. The work stations were poorly laid out and much wasted and duplication of effort was observed.

Actions Taken During Current Period:

During the first visit on April 4, 1983 the consultant met with company representatives and toured the production facility. A preliminary discussion of the company's problems and areas where the consultant could be of service was held. In addition to providing information on the new stator material the company asked for any general observations the consultant might make on improving the efficiency of the production line.

During the second visit on April 14, 1983 the consultant presented a stator from a Westclock electric motor. The material in the motor in cold rolled C1005 steel (5% C, 35% MN, 60% Fe) with a Rockwell B hardness less than 55. The material is available from the U.S. at approximately 32¢ per pound (2 pound/sq.ft.). This would be approximately 1/10 the price the company is paying for the current stator material.

The company representative was very pleased with the prospect of a significant cost reduction and asked if it would be possible to obtain sufficient material (approximately 1 sq. ft.) upon which he could run tests. The consultant promised to write to the steel distributor in the U.S. and ask for a test specimen (a copy of that letter is attached to this report). In addition, the company representative was provided with the name and address of the supplier in the U.S. and the name and phone number of the supplier's metalurgest in the U.S. as follows:

Worthington Steel Company
P.O. Box 37
Catawba, South Carolina 29704
U.S.A.

Mr. Tom Rennix, Plant Manager (803) 324-4140

Mr. Tom Flunnery, Purchasing Agent (803) 324-4140

Mr. Tom Zimmerman, Chief Metalurgist (614) 438-3210

During this visit the consultant also made several suggestions relating to methods engineering which, it was felt, would improve the efficiency of the production line. Both the plant manager and the president stated, however, it would not be possible to implement the suggestions at this time since it was the company policy that the method for doing a job was determined by the worker and no changes could be implemented without the worker's approval. They had previously tried some of the suggestions, but had met with worker resistance, because either the worker felt it was more difficult to do the job that way (resistance to change) or that perhaps the increased efficiency might eliminate jobs.

In any case, the manager gratefully accepted the suggestions, but indicated that they would probably not be implemented at this time.

Future Actions:

The consultant provided the company manager with his address in the U.S. and offered his services in obtaining further information about the new stator material or assisting in placing a purchase order.

Observed Results and Company Reaction:

The client was extremely pleased with the prospect of obtaining less expensive material for the electric clock motor

stator. They will test the material when the sample arrives, and if it is satisfactory will undoubtedly switch to the new material.

The client was very appreciative of the consultant's suggestions for improved work station layout and production methods, but will probably not implement them until such time as the worker-management relationship changes.

KOREA CREDIT GUARANTEE FUND
DAE WOO BLDG SEOUL KOREA 100
C.P.O. BOX 1029 TLX: KCREDHQ K 23151 TEL: 77 -59

April 25, 1983

Mr. Tom Rennix
Worthington Steel Co.
P.O. Box 37
Catawba, South Carolina 29704
U.S.A.

Dear Mr. Rennix:

You may recall that several weeks ago I spoke to you concerning the C1005 cold rolled steel that you supply to the Westclock Co. in Athens, Georgia. I stated at that time that I was working for Georgia Tech on a project with Korean Credit Guarantee Fund, and that I would be visiting Seoul, Korea in a effort to improve the technology of some of the Korean industries. I was particularly interested in the use of the C1005 steel by Rolens Watch Co. in Seoul.

I have now visited the company, and they are very anxious to obtain a sample of the steel upon which they might perform some tests. I told them I felt sure Worthington Steel would be happy to send them a sample and that I would write this letter requesting it.

KOREA CREDIT GUARANTEE FUND
DAE WOO BLDG SEOUL KOREA 100
C.P.O BOX 1029 TLX: KCREDHQ K 23151 TEL: 771-59

They would like approximately 1 square foot of C1005 with a Rockwell B less than 55. They would prefer sheets 0.5mm and 1.0mm thick, but if the only material you can supply is .005 in (as you supply to Westclock), that will be satisfactory.

Please send the sample to:

Mr. Choe, Tae-Seon
Rolens Watch Ind. Co., Ltd.
C.P.O. Box 7680
Seoul, Korea

If there is an expense involved, please invoice Rolens Watch Co. and they will remit by return mail.

Thank you for your cooperation.

Sincerely,

James W. Bannerman, P.E.
Georgia Tech Extension Service

Copy: Mr. Choe, Tae-Seon
Korea Credit Guarantee Fund

YU IL CORPORATION

YU IL CORPORATION

(Company A)

Dates Visited:	April 11, and April 28, 1983
Company Representative Involved:	Mr. Chong, Plant Manager Engineering Manager
KCGF Staff Involved:	Mr. Seon Yong Hoon Mr. Shin Jung Sup

Description of Company:

The Yu Il Corporation produces a line of office furniture with major emphasis on metal desks and filing systems. The company produces over 150 different products in its two plants which employ approximately 200 workers. Total gross sales in 1982 were in excess of 3 billion won ($4 Million) all destined for domestic consumption within the Republic of Korea.

Previously Observed Problems and Questions:

During the preliminary survey visit by the GIT field engineer, the following problems and questions were noted:

1. Current spot welding procedures produce dimples and surface blemishes. Company wants information on how to eliminate this problem.

2. Current plant layout is inefficient. Company wants information on how to lay out the production facility in an efficient manner.

3. Company feels they have a problem with their painting methods. They would like information about automatic painting systems.

Observed Problems and Questions During Current Visit:

1. In addition to the problems cited above it was observed that there is no systematic method of storing the finished product. The allocated storage space is inadequate for the volume of product to be stored.

Actions Taken During Current Visit:

During the first visit on April 11, 1983 the consultant met with company representatives and toured the production facility. A preliminary discussion of the company's problems and areas where the consultant could be of service was held. In order to develop a solution to the spot welding problem, the company was asked to provide data on the existing welding methods, specifically:

(a) Sheet metal thickness and composition.

(b) Welding electrode size (diameter) and shape.

(c) Welding hold time and squeeze force.

(d) Welding current.

(e) Cycle times.

During the second visit on April 28, 1983 the company representative was unable to produce the requested data which would enable the consultant to analyze the spot welding problem. The company representative stated that the operation of the welding equipment was the worker's prerogative and that management was reluctant to interfere by asking for data or setting operating procedures and standards. They stated that over the years the operators had tried many times to eliminate the problem but had always been unsuccessful therefore they felt that a solution was impossible. If, however, the consultant would give them a set of instructions that would eliminate the problem they would try to follow them.

The consultant emphasized that dimpling was a very prevalent problem in spot welding and could be eliminated only by a systematic analysis and controlled experimentation. The consultant explained that the four factors which influenced weld characteristics (including dimpling) were:

1. Weld current and cycle.
2. Electrode size and shape.
3. Squeeze pressure.
4. Metal composition and thickness.

Each of the factors could be varied independently or in combination to achieve a "welding schedule" which would produce the desired characteristics.

The consultant outlined very precisely the steps required to arrive at an acceptable welding schedule. The consultant also provided a copy of the chapter on resistance welding from the Metals Handbook. That chapter outlines the steps to follow in establishing a welding schedule. The client stated that they had a copy of the Metals Handbook but felt that the procedures outlined are too complex for them them to follow. What they wanted was someone to just tell them how to weld without blemishes.

The consultant provided the following additional documents relating to welding equipment and procedures:

1. Copies of the appropriate pages (15834 thru 15843) of the 1982 Thomas Registers listing manufacturers of resistance welding equipment.
2. Berkeley Davis Co. catalogues on the following equipment:
    a. Resistance welders.
    b. Bench welders.
    c. Press type welders.
    d. Rocker arm welders.

3. A list of publications and order information from the Resistance Welder Manufacturers Association, Philadelphia, Pa.

In response to the request for information about automatic painting systems, the consultant provided brochures and an explanation of the Ransburg Electrostatic Spray Painting System. The equipment is used extensively for automatic painting systems in the U.S. and should suit the Yu Il needs very well. The consultant explained the theory and areas of application of Electrostatic Painting Systems.

The consultant provided a copy of Chapter 6 from Plant Layout and Materials Handling by J. Apple. This chapter describes conventional techniques for analyzing materials flow in a manufacturing facility. The contents of the chapter were discussed and the consultant explained how the techniques should be applied to improving the plant layout at Yu Il Corp.

Future Actions:

The consultant has provided all the explanations, instruction and documentation necessary for the client to solve the identified problems. If the client elects to implement the recommendations he may require some follow-up technical assistance. As explained in the next paragraph, however, the client did not indicate which, if any, of the suggestions he planned to adopt.

Observed Results and Company Reactions:

The client was very receptive and appreciative of the consultant's research and documentations. Although it was not stated, it appeared that

the client will be somewhat reluctant to adopt the suggestions. The client gave the impression that a systematic analysis of the spot welding problem would be beyond the capability of his staff. He preferred a trial and error effort or a "magic wand" solution. The client will probably attempt to improve his plant layout by following the procedures provided. He probably will not take any further action relative to the automatic spray painting system since it would involve an expenditure of funds for new equipment.

DONG KWANG COMPANY LTD.

DANG KWANG CO., LTD.
(Company I)

Dates Visited: April 7, April 15 and April 21, 1983

Company Representative Involved: Mr. Han Kyou Kim (Director)

KCGF Staff Involved: Mr. Shin Jung-Sup

Background:

The Dang Kwang Company manufactures cloth and plastic luggage under contract to Samsonite and Sears, Roebuck and Co., as well as for Korean domestic consumption. The company's single plant, located on the outskirts of Seoul, employs 300 people, and produces over 100 different styles of luggage with 70% exported to the U.S. and West Germany. Their gross sales in 1982 were approximately 3,400 million won ($4.5 million).

Previously Observed Problems and Questions:

During a survey visit by a GIT field engineer, the company representative related the following problems:

1. They need information about equipment to install zipper stops (bottom stops).
2. They need information about techniques for sewing long seams and making the material ends come out even.
3. They desire information on modern sewing machines and accessories as well as materials handling equipment.
4. They desire information on sewing plant layout methods.

Observed Problems and Questions During Current Visit:

In addition to the problems identified above, the current consultant observed the following:

1. The company needs information about a large shear which will cut up to 50 ply of p.v.c. 60 inches wide. The company's current machine is limited to a 37 inch width (the director stated it didn't work well). They currently cut the material on the floor with a steel straight edge and a razor blades
2. The company has never established standard times for any of its products so is not able to forecast the duration of production runs to meet the specific orders. They would like information on how to establish standard times.

Actions Taken During the Current Period:

The consultant made three visits to the client's production facility during the current period. On the initial visit the consultant met with the plant director and discussed the problems and questions identified by the GIT field engineer during the survey visit. The consultant then toured the production facility at which time the additional problems listed above were identified.

During the initial visit the plant director stated they were anticipating a week long visit by the representatives from the Korean Small and Medium Industry Promotion Corp. (SMIPC) and their consultant. The director further indicated that the SMIPC consultant would work on the problem of plant layout and production forecasting, and that he would like the GIT consultant to provide information on modern sewing plant and materials handling equipment

and assist the SMIPC consultant with the other problems. It was agreed that the GIT consultant would meet with the SMIPC consultant at the end of the following week to discuss the progress made by the SMIPC consultant and identify areas where the GIT consultant could be of further service.

During the second visit the GIT consultant met with the plant director and the SMIPC consultant. During the four days that the SMIPC consultant had spent in the plant he had identified problems with the production equipment and methods. It was interesting to note that the problems were almost identical to those identified by the GIT field engineer and consultant. It was agreed that in the four days he had remaining in the plant, the SMIPC consultant would construct an "operation process chart" and obtain standard times for each operation. The GIT consultant on the next visit would then use that data to perform a "line balance" and instruct the plant director in the techniques of production forecasting. It was agreed that due to the fact that the company produces over 100 different styles of luggage, and that each style required a separate production set up, it was more important to instruct the company representative in methods of determining standard times and making production forecasts than in developing such data for a specific production run which would be obsolete at the end of the run.

The consultant provided a number of catalogs describing modern leather and plastic sewing machines and equipment (see attached list of documentation). The consultant went thru the catalogs with the client highlighting specific equipment which was particularly appropriate to the client's needs. The consultant recommended that the client give consideration to the acquisition of the following equipment when replacing his existing machines:

1. Pfaff 335-H3-6/01(.900/52) cylinder-bed sewing machine. This single needle cylinder bed sewing machine is one of the most frequently employed machines, for sewing bags, soft suitcases and leather craft articles. It is equipped with unison feed, horizontal rotary hook and 46 mm diameter cylinder bed. It can be fitted with a thread puller/trimmer, an automatic presser foot lifter, and/or an automatic needle positioner. Due to the slender cylinder bed the machine is particularly well suited for sewing concave tubular work pieces which occur especially in the leather goods industry. The combined action of the three feeding mechanisms ensures that materials are joined evenly without any interply shifting. This attribute should solve the client's problems of uneven seams.

2. Pfaff 1295 - 706/35 - 17/01 - 940 Post bed Sewing Machine. This machine is equipped with a compound feed, large vertical rotary hook and a bobbin that holds 60% more thread than the standard version. Its triple feed ensures that multiple pieces of material having different thicknesses or a rough, slippery or tacky surface will be fed at a uniform rate. The machine is excellent for sewing bags and soft suitcases, and should serve the client's desire for larger bobbins as well as the seam malalignment problem.

3. Pfaff 1245 - 706/05-6/01 Single Needle Flatbed Sewing Machine, has a unison feed, large rotary hook and bobbin which holds 60% more thread than standard models. The areas of application of this machine are almost unlimited and include all normal sewing

operations in the leather goods industry. There are a number of attachments which make this machine adaptable to many special sewing jobs. The machine is of special sturdy construction making it particularly suited to application where maintenance may be a problem. This machine can be fitted with a double needle for sewing zipper tapes.

4. Several other general and special purpose machines were discussed with the client.

The consultant provided documentation and catalogs on automatic zipper stop machines. The consultant described the operation of such machines and discussed the advantages of metal staple zipper stops over sewn ends. The consultant recommended that the client consider acquisition of an automatic bottom stop machine similar to those described in the CARBIDE or MURKO catalogs (see list of provided documentation). The price of such a machine would be approximately $3,300 FOB U.S.A. The consultant discussed ordering procedures in the event the client decided to adopt the recommendation.

During the third visit it was discovered that the SMIPC consultant had not developed the "operation process chart" or established standard times. It would, therefore, not be possible for the GIT consultant to perform a line balance. Instead the GIT consultant met with the plant production supervisor and instructed him in the methods of developing the "operation process chart" and the "flow diagram" and using these documents to design an improved plant layout and efficient materials flow.

The consultant provided a copy of Chapter 6 (Conventional Techniques for Analyzing Material Flow) and Chapter 11 (Space Determination) from

Plant Layout and Materials Handling by J. M. Apple. The consultant also provided a copy of a set of procedures for "Sewing Room Production Systems" developed by Kurt Salmon Associates Inc.

Future Actions:

It is felt that the documentation provided, along with the technical instructions given to the plant personnel afforded answers to the questions and provided the techniques by which the company could solve most of the problems identified in both the survey and current visits. The principal remaining problem concerns the large shear. The consultant agreed that upon his return to the U.S. he would obtain information on the shear and forward it to the client thru KCGF. The consultant also agreed to investigage the existence of a sewing machine accessory which will cut a welt tape prior to the needle in a welt sewing operation. (This may be impossible, but the client claims to have seen such an attachment in Taiwain.)

Observed Results and Company Reaction:

The client was extremely pleased with the documentation, catalogs and brochures concerning modern sewing room and materials handling equipment. He indicated he intended to follow the consultant's recommendations and would replace much of his existing worn out equipment with the new machines.

The client was very receptive and appreciative of the instruction on production planning techniques. Although implementation may be beyond the technical ability of the plant personnel at this time, they are at least aware of the problem and probably will attempt to use a "flow diagram" to

improve the materials flow thru the production facility. It is quite possible that they may hire a local consultant to perform a complete work study to determine standard times and produce a production schedule.

Documents, Catalogues and Brochures provided DANG KWANG, CO. during Second Visit April 15, 1983

1. SANBRAND catalog #231, 1982 edition. Sandbrand Co., 3900 Green Industrial Way, Atlanta, Ga. 30341. A Complete Catalogue of Cutting, Sewing, Finishing and Warehousing Equipment, Parts and Accessories.

2. Instruction Manual for Operation and Care of Series 1730 Staple Bottom Stop Machines, TALON Corp., 626 Arch Street, Meadville, Pa. 16335.

3. Catalog of CARBIDE Automatic and Semi-Automatic Machines for Zipper Industry. CARBIDE Corp., 1631 63rd Street, Brooklyn, New York, 11204

4. Brochure of MURKO Zipper Chain Machines and Assembly Equipment. MURKO Machinery and Die Corp., 32-38 62nd Street, Woodside, New York 11377

5. PFAFF Special Service Catalogue # 71-01, 1982 Edition. PFAFF PEGASUS Corp., Green Industrial Way, Atlanta, Ga. 30341. A Catalogue of Machines for the Production of Handbags and Suitcases.

6. PFAFF Special Service Catalogue #001-01, 1982 Edition. PFAFF PEGASUS Corp., Green Industrial Way, Atlanta, Ga. 30341.

A range of machines catalogue giving technical details on the equipment described in catalogue #71-01.

7. Photograph of Zipper Stop Machine used by YKK Zipper Co. 1306 Industrial Drive, Marietta, Ga. 30065.

SAM SHIN IRON IND. CO. LTD.

SAM SHIN IRON IND. CO., LTD.

(Company J)

Dates Visited: April 8, April 26, and April 29, 1983

Company Representative Involved: Mr. I. G. Kim
Chief, Quality Control Section

KCGF Staff Involved: Mr. Shin Jung-Sup

Background:

The Sam Shin Iron Ind. Co. is a manufacturer of forged steel valves and fittings. There are 135 employees at the Inchon plant which produces approximately 12,000 valves per month in 50 different models. The company's gross sales in 1982 were 2.5 billion won ($3.3 million) of which 60% was for domestic consumption and 40% exported to the United States, Holland, and Southeast Asia.

Previously Observed Problems and Questions:

During the original survey visit the field engineer reported the following problems and questions:

1. The company wants to purchase books on high pressure valve design and manufacturing They need a list of current books and ordering information.

2. The company wants to manufacture ASME "N" stamp valves. They need information about obtaining ASME nuclear certification.

3. The company wants to upgrade their existing machinery. They need information about numerical controlled (N.C.) machines including cost justification.

4. The company wants information on modern forging technology.

Problems and Questions Observed During Current Visit:

1. The Quality Control Section Chief reports that his staff is spending too much time on quality control tests. They desire information on how to reduce the amount of testing and still stay within the scope of Mil. Standard 105 D.

2. The company has a Rockwell hardness tester, but does not have a calibration standard.

Actions During Current Visit:

During the first visit the consultant met with the client's representative and discussed the problems identified by the GIT field engineer during the survey visit. The client stated that the problems still existed and that the consultant's interpretation was correct. The consultant and KCGF staff toured the production facility and in a subsequent discussion identified the additional problems cited above.

During the second visit the consultant provided documentation and made recommendations relative to each of the problems identified in the survey visit. The documents and recommendations (keyed to the specific problems cited above) were as follows:

Problem #1 - Books on high pressure valves

(a) The consultant provided a Xerox copy of the title page, table of contents and preface of the following books and articles:

1. Hutchison, J. W., ISA Handbook of Central Valves. 2d Edition. Instrument Society of America, Pittsburg, 1976.

2. Lyons, Jerry L., Lyons Valve Designers Handbook, Von Nostrand Reinhold Co., N. Y. 1982.

3. Lyons, J. L. & Askland, Lyons Encyclopedia of Valves, Von Nostrand Reinhold Co., N. Y. 1972.

4. O'Keefe, William, "Learn Fluid-handling Lessons from Nuclear Isolation Valves and Activator Systems," Power, January 1981 (pp 68-71).

5. Pearson, G. H., Valve Design Manually Operated Pattern, Pitman Publishing Co., N. Y. 1972.

6. Schweitzer, Philip A., Handbook of Valves, Industrial Press Inc., New York - 1972.

7. Valve Technology, A Computation, Technology Utilization Office, NASA, 1970.

(b) The consultant provided copies of the appropriate pages (concerning valve technology) from the 1980 and 1981 editions of the Applied Science Technology Index.

Problem #2 ASME "N" Stamp

(a) The consultant provided the following documentation:

1. ASME application (form letter N.1) for nuclear certificates of authorization and code symbol stamps.

2. Forms and work sheets to be completed prior to a certification survey.

3. Order form and instructions for ordering the ASME Boiler and Pressure Vessel Code.

4. Order form and instructions for ordering the Proposed Standard for Functional Qualification Requirements for Power Operated Active Valve Assemblies for Nuclear Power Plants, ASME, 1983.

5. A copy of the part of the ASME Boiler and Pressure Vessel Code, Section III, relating to quality control standards.

6. A copy of the ASME "N" stamp certification "Quality Program Survey and Audit Checklist.

7. A list of companies authorized to witness nuclear certification quality control tests.

8. The name and contact information of a U.S. company willing to assist ($50 per hr. + expenses) with obtaining ASME certification.

9. The name and phone number of an ASME contact for questions relative to "N" stamp certification.

(b) The consultant estimated that the cost of obtaining an "N" stamp certification would be approximately as follows:

Survey team $30,000 + expenses	$ 60,000
Consultant services $15,000 + expenses	30,000
Upgrading Company Q.C.	60,000
Total approximate cost	$150,000

In light of the high cost associated with such certification, the consultant recommended that the Sam Shin Iron Ind. Co. investigate the alternatives of sub-contracting to provide valves and fittings to a company which already possesses the "N" stamp certification.

Problem #3 Information on N.C. Machines

(a) The consultant prepared and presented a cross-tabulation of the attributes of five different numerical control systems (A copy of the tabulation is attached.)

(b) The consultant provided the following:

1. A copy of the appropriate chapter (N.C. Machinery Guidelines) from the Machinery Data Handbook, 3rd Edition. Machinery Data Center, Cincinnati, Ohio.

2. Ordering information from the Machinery Data Handbook and other publications of the Machinery Data Center, Cincinnati, Ohio.

3. A brochure and equipment description from the Allison Machinery Co., Atlanta, Ga. The documentation described the following equipment:

   a) Turning centers

   b) Vertical milling centers

   c) Machinery cells.

4. A brochure and equipment catalog from the Schmiede Machine and Tool Co., Atlanta, Ga. The documentation described the following N. C. systems:

a) Bendix System 10

b) Puma 10

c) BMC - 8B.

5. Copies of the following articles from current technical journals:

a) Duquetta D. Remanufacturing: The Evolving Crisis in Re-Industrialization, COMMLINE, July-Aug. 1981 (pp 28-30)

b) Gehrels, J. C., Numerical Control Technology, COMMLINE March - April 1982 (pp 14-44).

c) Makino Milling Machines, Metalwork, Sep. 1980 (pp 99-102).

d) Thomas, D.W., The Impact of N.C. on Quality Control, COMMLINE, Sep-Oct. 1981 (pp 20-21).

6. A check list of 44 points to consider for the justification of N.C. machinery reprinted from Modern Machine Shop, Allison Machinery Corp., Atlanta, Ga.

Problem #4 Forging Technology

The consultant provided a copy of the title page, table of contents and preface of: Jensen, J.G., Forging Industry Handbook, Forging Industry Association, Cleveland, Ohio 1970.

The consultant then discussed most of the above described documentation with the client and pointed out the sections, equipment and articles which were most appropriate for the Sam Shin Iron Ind. Co. Ltd.

During the second visit the consultant also provided 4 calibration standards for use with the company's Rockwell hardness test. Three of the standards the

consultant had manufactured himself and the fourth standard was a certified calibration standard obtained commercially. The hardness of the standards ranged from Rockwell C 25 to C 60.

An Analysis of the Attributes of Five Numerical Controlled (N.C.) Machines

		CINCINNATI MILICRON	OKUMA & HOWA ACT 3	HITACHI SEIKI 3NE-300	PUMA-10	MORI-SEIKI SL 3A
	COUNTRY	USA	JAPAN	JAPAN	KOREA	JAPAN
CONTROL FEATURES	MFG. OF CONTROLS	AUTOMATIC TOOL	FANUC 3TF	FANUC 6TB	FANUC 6TB	YASNAC
	1. CONVERSATIONAL	NO	YES	EXTRA	NO	NO
	2. INTERFACE SHARE	NO	YES	NO	NO	NO
	3. STD CODES	YES	YES	YES	YES	YES
	4. PARAMETER CHANGE	NO	YES	NO	NO	NO
	5. DIAGNOSTIC FEATURES	YES	YES	YES	YES	?
	6. CONSTANT SF. SPD.	YES	YES	YES	YES	YES
	7. POINT TO POINT MOTION	YES	YES	YES	?	?
	8. UPDATEABLE	?	YES	?	?	?
REPUTATION OF CONTROLS		GOOD	EXCELLENT	EXCELLENT	EXCELLENT	GOOD
SERVICE ACCESSIBILITY		LOCAL	LOCAL	LOCAL	LOCAL	?
SWING (IN)			18.11	23.75	23 7/32	15.7
DISTANCE BETWEEN CENTERS		20 IN.	23.62 IN	24.00	24.8	24
WAY CONSTRUCTION		SLANT	SLANT	STD	STD	SLANT
MACHINE WEIGHT (LBS)		11500	9200	6200	9600	9350
MAX. DIA. OF BAR STOCK (IN)		1.75	1.75	1.6	3	1 1/2
SPEED RANGE (RPM)		40-4000	35-3500	100-4000	20-2500	30-3200
NUMBER OF TOOL ON TURRET		12	10	12	12	12
PRICE OF MACHINE		$98 850	$68,500	$ 90000	$ 75000	$100 000
PRICE OF TOOLING		$1000	$ 1000	$ 1000	$ 1000	$ 1000
PRICE OF ROBOT ATTACH.		$50 000	$15 000	?	?	
POWER REQUIREMENTS		60 KVA	60 KVA	60 KVA	60 KVA	60 KVA
INSTALLATION CHARGES		$ 300	$ 300	$ 300	$ 300	$ 300
SHIPPING CHARGES		$1500	FOB STI	$ 1500	$ 1500	$ 1500
MULTI VOLTAGE XFORMER		NO	YES	NO	NO	NO
COST FOR WIRING		$ 400	$ 400	$ 400	$ 400	$ 400

SAM JUNG ELECTRIC IND. CO. LTD.

SAM JUNG ELECTRIC IND. CO. LTD.

(Company M)

Dates Visited: April 12 and April 19, 1983

Company Representatives Involved: Mr. Y. H. Ku
Chief of Development Division

Mr. K. S. Olt
Director of Engineering

Mr. D. O. Lee
Director of International Dept.

KCGF Staff Involved: Mr. Shin Jung-Sup

Background:

The Sam Jung Electric Industrial Co. Ltd. is a manufacturer of automobile radios. It employs 400 workers in the company's only plant located outside the city of Seoul. The 1982 gross sales totaled 4 billion won ($5.3 million) with approximately $1.4 million exported to the U. S. and Europe.

Previously Observed Problems and Questions:

During the survey visit by the GIT field engineer, the company representative reported three problems.

1. A noise problem associated with the final quality control check. The company requested information on QC equipment.
2. The company requested information about in-process QC checks and procedures.
3. The company requested information and suggestions on establishing an organizational structure to support a product development activity.

Observed Problems and Questions Current Visit:

By a letter dated February 7, 1983 (copy attached) the previous consultant assumed responsibility for problems 1 and 2 identified above.

On the initial visit to the plant the current consultant was informed that the company management had changed and that the new management did not perceive any problem as described in item 3 above. In fact the company representative stated that he knew of no problem with which the consultant could be of assistance.

Actions During Current Visit:

During the first visit on April 12, 1983 the consultant met with the company management representatives in the corporate office in Seoul. As stated previously the new management could not identify any problems or questions with which the consultant could be of service. Since, however, the consultant had performed significant research on the previously stated problem of product development organizations, the company representatives stated that they would be interested in a briefing and copies of the source documents relating to the research. Between the first and second visits the consultant prepared a summary paper describing the Matrix Organizational Structure with particular emphasis on how such a structure could be used by Sam Jung Electric. A copy of that paper is attached to this report.

During the second visit on April 19, 1983 the consultant briefed several representatives of the Sam Jung Electric Co. management on the characteristics, benefits and disadvantages of a Matrix Organizational Structure. The paper described in the previous paragraph was presented along with copies of the references and source documents. (A bibliography of those documents is attached to this report.)

Future Actions:

The company representative did not identify any areas where the consultant could be of further service. There appears to be no future action required.

Observed Results and Company Reactions:

The company representatives were very receptive and seemed to be interested in the new management concept prepared by the consultant. Since, however, they do not perceive that they currently have a problem there is some question as to whether they will incorporate the suggestion in their management structure. The representatives stated that they would pass the information on to their supervisors for further consideration.

Georgia Institute of Technology
ENGINEERING EXPERIMENT STATION

INDUSTRIAL EXTENSION DIVISION
Savannah Area Office
P. O. Box 13817
6606 Abercorn Street
Savannah, Georgia 31406
Area Code 912/356-2390

February 7, 1983

MEMORANDUM

TO: Dr. Ken Maddox
International Programs Division/TAL

FROM: Larry Edens, Savannah Area Office
Industrial Extension Division/EDL

SUBJECT: KCGF PROJECT -- A-3333-000

Today, Jim Bannerman and I agreed to the following changes in the Project Assignments, in order to avoid duplication of research effort:

(a) I will address problems 3 and 4 for Bukdoo Eumhyang Co. ("O") which pertain to Speaker Cone Technology.

(b) Jim will cover problem 3 for Sam Jung Electric Ind. Co. ("M") regarding Product Development Organizational Methods.

Note that the above changes do not involve the highest priority problems listed by either company.

c: Jim Bannerman
Jim Muller

The Matrix Organizational Structure

A Paper Prepared for

SAM JUNG ELECTRIC CO., LTD.

by

James W. Bannerman P.E.

GIT Consultant to the

Korean Credit Guarantee Fund

Seoul, Korea

April 1983

CURRENT ORGANIZATIONAL STRUCTURES

Most common forms of industrial organizations group together activities which have a common basis: that is a common product, a common customer, a common geographical area, a common function, (engineering, management, manufacturing, etc.) or a common process (forging, machinery assembly, etc.). Each of these bases have various costs and economies associated with it. The functional structure, for example, permits the hiring of technical specialists and using them across product lines. Fewer specialists are therefore needed and efficiency is increased. The technology is also supported in that the specialists can keep abreast of developments in their area of expertise. This capability is essential if the organization is going to develop high technology products. The tasks that the organization must perform, however, will require varying amounts of specialization in varying sequences. It is almost impossible, under a functional organization to complete all the tasks on time with the stipulated quality and still make efficient use of the specialist's time. The peaks and valleys of demand for specialized resources necessitate a highly coordinated effort with long lead time and conserable planning.

In contrast, the project or product organization facilitates co-ordination among specialists to achieve project goals. It allows quick reaction capability and reduces the impact that a problem in one area of a project might have on other areas of the project. The problem is that specialists must be hired for each project with no cross-project utilization. This generally requires duplication of cost with resulting inefficiencies. In addition, when assigned to a product or project team, the specialist tends to lose his identity in the technical speciality as he gains experience in the project or product.

No one keeps abreast of new developments in the technical speciality; a requirement as stated previously for organizations involved in high technology products.

"The problem is that when one basis of organization is chosen, the benefits of the others are surrendered. If the functional structure is adopted, the technologies are developed but the projects fall behind schedule. If the project organization is chosen, there is better cost and schedule performance but the technologies are not developed as well."(4:30) Whether technical developments, or schedule completion, what generally happens is that top management decides which is more important and then chooses an organization which supports his decision.

The Matrix Organization Design

An emerging organization design called Matrix Organization attempts to maximize the strengths and minimize the weaknesses of both functional and product structures. In this organizational design personnel are assigned to two units within the company. They have a functional responsibility and are assigned to their functional unit as a "home base" when not operating under project or product responsibility. Each specialist therefore has a dual responsibility. When a need arises he serves on a project team representing his technical speciality, under the leadership of a project director. For example, if Sam Jung Electric Co. is planning to introduce a new product they might form a "product development project." Specialists from engineering, manufacturing, marketing and finance would be called to serve on the product development team under the leadership of a project director (possibly from the company executive management). The team would function as a separate entity

performing all the functions of product development ie: Research and Development Market Analysis, Production Planning, Product Financing, Manufacturing Layout, Quality Control Planning and Sales and Distribution Planning. When the product entered the phase of routine production the team members would return to their individual functional units and meet occasionally as a team, on the call of the project director, to review the status of the project.

If the company expanded to the point that several products were under development simultaneously, the functional areas would also expand to provide the resources to support the simultaneous projects. Some of the projects might require continuous surveillance in which case a project director could be assigned on a permanent basis. He could then call upon his team as conditions warranted after the product was in routine production.

It is very conceivable that a technical specialist might belong to three or four project teams, however, since he would serve on only one team until the product was in regular production before being assigned to a subsequent team, almost assuredly, the majority of his projects would be operating in a routine manner without much demand on his time.

Disadvantages of Matrix Design

Matrix organizations are not without fault and problems. Most of the problems (at least for a small company using Matrix management) can be attributable in the final analysis to corporate leadership. By the same token, elimination of these problems and smooth operation of the Matrix design can be achieved thru correct "high level" management actions.

Some of the pitfalls of Matrix organizations, and how management can help to forestall them are listed as follows:

Problem: Since each team member has two bosses, (the functional unit leader and the team leader), there sometimes exists a conflict of interest and a disloyalty to either the functional unit or the team.

Solution: Management must emphasize that the team member has complete autonomy as far as the functional unit is concerned, when serving in his team capacity. Team members must be selected on the basis that they will act in the best interests of the company, even if it means subordinating the team or functional unit goals. Promotion, recognition and rewards must come as a result of performance to the company, not necessarily to either of the assigned units.

Problem: The specialist tends to become polarized towards either the team or his functional unit.

Solution: Not all people are good team workers nor do all people have the flexibility to change their inclination as conditions dictate. Top management must make a concerted effort to select people who will function well under the Matrix design.

Problem: Design by a committee is frequently ineffective and inefficient. Sometimes teams tend to emphasize what is wrong rather than find ways to do it right.

Solution: The team leader must have outstanding human relations skills. Specialists tend to be individualistic, egocentric and myopic. The team leader must be chosen with great care to assure that he can cope effectively with the divergent interests of the people with whom he will serve.

Getting the Matrix Started

One of the most important first steps in establishing a Matrix organization, in light of the problems identified above, is to communicate to all concerned that a Matrix organization is not just an extension of the existing pyramidal structure. "The pyramidal structure acquires its form from the fact that as one goes up the administrative ladder (1) power and control increase, (2) the availability of information increases, (3) the degree of flexibility increased, (4) the scope of the decisions made and the responsibility involved increases.

Implicit in the Matrix organization are almost opposite tendencies. For example, power and control are given to the individual and/or the group who have the technical skill to accomplish the task, no matter what their organizational level. Thus a team could be composed of five people,representing all different levels of authority,who are equal. The group could be chaired by the individual or group with the least organizational authority. "The group or individuals must be given responsibility and authority to make decisions at the widest necessary scope." (1:48)

Conclusions

Matrix organizations are not well-suited to all companies. A Matrix organization is a bureaucracy in which authority is delegated to the individual best qualified to perform a specific task without regard to his status within the organization. It is a progressive management organizational structure and can only operate in a progressive environment. Top management must be willing to give up many of its prerogatives and insist that each lower echelon of management do the same if the system is to work.

Matrix organizational structures are suited to companies which are progressive in their product development while maintaining a production level of standard products. If the company is not particularly interested in being "first-on-the-street" with a new product then perhaps the functional organization or the project organization will best suit their needs.

If, however, the company must produce a routine product and at the same time develop new products dependent on the state of the art in technology then Matrix organizations offer an unequalled opportunity to do both jobs well.

Acknowledgement

Much of the information in this paper was taken from the documents attached. In some cases, due to the nature of the paper and time constraints, full credit is not given in the form of footnotes. For this reason the paper should not be reproduced, published or distributed. It is prepared for the sole use of the SAM JUNG ELECTRIC CO. LTD. and not general dissemination.

Documents provided to SAM JUNG ELECTRIC CO. LTD.

1. Argyris, Chris; Today's Problems with Tomorrow's Organizations, The Journal of Management Studies, Feb. 1967 (pp 31-55)

2. Davis, Stanley M. and Lawrence; Problems of Matrix Organizations, Harvard Business Review: May-June 1978 (pp 131-142)

3. Galbraith, Jay R. Matrix Organization Design, Business Horizons, Feb. 1971 (pp 29-40)

4. Gibson, James L. et.al. Organizations, Business Publications Inc. Plano, Texas 1982 (chapter 11, "The Anatomy of Organizations")

5. Knight, Kenneth; Matrix Organization: A Review, The Journal of Management Studies, May 1976 (pp 111-130)

6. Sisk, Henry L. & Williams; Management & Organizations, Southwestern Publishing Co., Cincinnati, Ohio 1981 (chapter 9: "The Structural Design of Organizations")

Project A-3333

Management and Technical Assistance Program To Korea Credit Guarantee Fund Loan and Lease Guarantee Companies

by

James C. Muller
Senior Research Engineer

This report covers on-site consultation,
May 14 - June 17, 1983

Industrial Extension Division
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

July 1983

Table of Contents

INTRODUCTION

This report covers field activities from May 14 to June 17, 1983. During this period, the GIT field engineer, Mr. James Muller, made 17 visits to six companies. The purpose of these visits was to provide information and assistance on problems identified on previous field visits and to respond to new requests and problems that arose in the interim.

By agreement between KCGF and GIT, problems for each company were pre-listed in priority order. Approximately two man weeks of research effort were spent on the problems before the field engineer's departure for ROK. The high priority problems were researched in great detail, with the rest of the problems researched proportionately less. Also, the high priority items were covered at length with the companies and the remaining problems were addressed as time permitted. A total of 32 problems were listed by the companies, the fewest being three and the most being 10 by any one company.

During the first visit to the companies, the previously listed problems were reviewed and clarified for the benefit of both the company and the GIT consultant. The scope of some of the problems was expanded in several cases, but no new problem areas were identified. This was fortunate because many problems already needed to be covered and research time and materials were very limited. The spectrum of the problems ran from very specific design and manufacturing requirements to current awareness requests. Most prevalent were the requests for the transfer of current technology. In this regard, the consultant provided very current articles on the subjects of interest from major technical publications and was prepared to instruct the company on the contents of these articles.

As always, the KCGF staff did an excellent job of scheduling the company visits and logistically supporting the GIT consultant. This GIT consultant had participated in the third-year project and noted significant improvement this time in the staff's fluency in both the English language and technical matters. The staff is now fully effective in delivering western technology to its companies and dealing with western consultants at any level.

SUMMARY

The GIT consultant was well received at all the companies. He was given a plant tour at each company and was permitted to take photographs in all but one instance. From one to six company managers/engineers participated in the consultation sessions, the average being three participants and in just one instance did only one participant attend. The participants were always the top operating personnel of the company and were well versed in the problem areas. The GIT consultant considers that the assistance provided to five of the companies was highly effective and in only one case was the assistance only moderately effective.

In almost every instance the GIT consultant noted a lack of technical literature (textbooks, handbooks, etc.) and technical publications (Machine Design, American Machinist, etc.) at the companies. The subject-specific literature provided to the companies by the GIT/KCGF project would have been impossible for the company to acquire on its own. The consultant also surveyed the technical literature holdings in the KCGF library and found there had been no noticeable additions in two years. However, the consultant is not considering any Japanese language additions, if any exist. The consultant urged KCGF to resume collecting broad-based technical literature from the U.S. and to promote an open library policy with its companies.

In regard to the above lack of technical literature and to promote a greater focus of interest in technical matters, the consultant proposed that KCGF become a catalyst in the formation of a Chapter of the Society of Manufacturing Engineers (SME) in Seoul. SME is an international organization with 15 offshore chapters. ROK, and particularly the area around Seoul, is becoming increasingly industrial. SME provides a very large library of technical materials to its offshore chapters which could be housed at KCGF provided that all members have access to the materials. The primary interest of this organization and its divisions -- Association of Finishing Processes (AFP), Computer and Automated System Association (CASA), Robotics International (RI) -- are parallel to KCGF and to ROK. The GIT consultant left printed materials on SME and a roster of current ROK SME members with KCGF. He also gave a slide presentation on SME to the staff members of the Engineering Extension Division of KCGF, and

to a group of engineers from Sam Yang Heavy Machinery Company. Sam Yang was the largest company receiving assistance, and the president of the company was very receptive to the possibility of participating in the start of an SME chapter in Seoul.

A brief summary of the technical assistance activities of the GIT consultant during his field visits from May 1 to June 17, 1983 is included as an Appendix. A draft summary was provided to KCGF prior to the GIT consultant's departure.

The body of this report contains detailed observations, discussions, deliverables, and recommendations concerning the technical assistance activities at the respective companies.

Kyung-Il Precision (Company B)

Dates Visited: May 17 and 27, and June 9, 1983
KCGF Staff Involved: Mr. Shin, Jung Sup
Principal Products: Auto and truck axle spindles

Previously Observed Problems or Questions

The company's problems/questions all relate to metal cutting. The company is machining forged steel axle spindle blocks to their final dimensions. They are bothered by continuous chips when turning this material and would like to know how to contend with them. They use drilling jigs to drill the hole patterns in the spindles, but the jigs wear out, quickly resulting in an out of tolerance condition. They use an extractor drill to drill through the spindles; the brand name is Sandvik. This drill has carbide inserts for cutting, and the company wants to be provided with sharpening specifications on these inserts. Virtually all turning is done on conventional lathes with carbide cutting tools and without cutting fluids. The company wants to know if it should use cutting fluids and what might be the benefits of doing so. The company wants methods and equipment, if available, to measure surface finishes by means other than visual comparison. The company is cutting large diameter external threads on the axles spindles by multiple passes on a lathe. They require better methods and equipment. The company will welcome any suggestions that might reduce machining time.

Observed Problems or Questions During Current Period

As happens only rarely, the consultant observed several prelisted problems/questions which were not actual problems at all.

One problem regarding holding a 0.03 mm tolerance on a 96 mm outside diameter was dispensed with immediately after it was discovered that rejections were only 3 in 1,000.

The consultant contacted Sandvik, U.S.A., regarding the company's desire to sharpen the carbide inserts on their BTA drills. The Sandvik technical representative related that this particular drill tip was relatively inexpensive and disposable, and that it should not be sharpened. In fact, it could not be

sharpened because once the insert experienced excessive flank wear the original hole size could not be recovered by any sort of grinding. Sandvik provided a technical catalog on the BTA drills, which the consultant delivered to the company together with the news about the throw-away tips. The company was not happy with this answer; they did not wish to throw the drill tips away. They chose to braze in new carbide blanks and grind their own geometry on them. The consultant could not comment on their geometry. He suggested that they try to locate an extractor drill with indexable carbide inserts, but added that the small size of the drilled hole didn't offer much hope of finding such a tool.

When the consultant viewed the multi-pass external threading operation he found that the firm wasn't using a lathe at all, but a single point threading machine. Evidently the company had acquired this machine in the interim between the preselection of the problems and the consultant's arrival. The consultant had brought information on this type of machine and specifications on several candidate machines. He could possibly improve the speed of the company's machine selection, but not appreciably enough to cause them to consider a change.

Action During Current Period

The company's machine shop produces only rotational parts. Most of the machine tools are lathes, and most of these are conventional type lathes. The workpiece is invariably a forged steel blank. The parts are produced in series, handed from one lathe operator to the next in small lots, but long runs of the same part. The cutting tools are all carbide inserts, cutting dry. It is a fairly efficient operation considering the type of machine tools employed.

The company's problem with continuous chips is real and troublesome. The consultant examined the inserts used and found that they had pressed in chip breaking groves. The inserts were triangular and square shapes. They were cutting with a positive rake angle. All things considered, they were doing most things right in breaking the chips up. There was no clear cut solution to the company's problem. The chips were wound up very tight in most cases and it appeared that they should break, but didn't. Nevertheless, the consultant

reviewed several pieces of research material on the methods and mechanism of chip breaking. He had some helpful hints for the company.

For best chip breaking efficiency, the depth of cut to feed ratio should be 10:1. This should improve chip breaking in the roughing operations. The finishing operations will still produce long stringy chips, but these are a little easier to handle. The company should try different combinations of chip breakers - those that produce chips at skewed angles to the workpiece as well as those perpendicular to and parallel to the axles of the workpiece. Chip breaking is unpredictable and one has to try every combination and adopt that which works best. Forged steel is literally and figuratively very tough when you are trying to break its chips.

The problem of drilling jigs wearing out and drilled holes out of tolerance in every manner imaginable is very common in Korean machine shops. Granted, Korean machinists are very skillful, but none of them can sharpen a twist drill on a bench grinder. It is impossible; drill point geometry is very complicated and very critical. You have to use a precision drill grinding machine, not the pencil sharpener variety and certainly not a bench grinder. Also, you have to have an operator who understands drill point geometry and how to operate the relatively complicated drill grinding machine.

The consultant explained this to the company management and provided them with a brochure on the Optima drill grinder, an excellent U.S.-made machine. He also recommended the Black Diamond drill grinder, almost a standard in the industry made by Black and Webster of Waltham, Massachusetts. Unfortunately, the consultant did not have price quotations on the machines. He did give some estimates and the company responded negatively to the high cost. He intends to get some approximate costs on these machines from the manufacturers on his return and send them to the company.

The consultant provided the company with several research articles citing the benefits of using cutting fluids with carbide tools. However, after careful consideration, the consultant instructed the company to ignore these articles and continue to cut dry for reasons and circumstances cited below.

Cutting fluids can be beneficial in many ways for cutting with any type of tool material: longer tool life, better surface finish, higher cutting speeds, less

power, etc. Carbide tools are very hard, but in some ways very fragile -- they are highly susceptible to developing cracks from thermal shock and/or temperature cycling. When this happens they can prematurely break, sometimes after only a few cuts. You must keep the carbide tool flooded with cutting fluid at all times to prevent thermal shock. Proper procedure for a lathe is to apply cutting fluid from both above and below the cut. This is possible only if you have the entire bed of the lathe enclosed in splash shields, which is, in turn, possible only for NC turret lathes. NC turret lathes are virtually the only type of lathe that can benefit from the use of cutting fluids and carbide tools. The company's system of using conventional lathes in series does not lend itself to the use of cutting fluids. It would be a disaster if cutting fluids were used. The place would be dripping in cutting fluid, the operation would be slowed down to adjust partially effective splash shields and there would still be frequent premature breaking of carbide inserts.

The consultant satisfied the company's request for information on methods other than optical comparison for checking surface finishes by supplying and reviewing several articles on laser and piseoelectric methods. He provided the company with literature and specifications on a commercially available device for doing this, the Surftest III sold by Mitutoyo of Japan. The company can easily get a demonstration of the device in Tokyo, or perhaps even Seoul, along with a price quotation.

The consultant's suggestion for reducing machining time is pervasive. This operation is a natural for a CNC turret lathe. One such machine could perform all of the operations on one end of the spindle and another machine could perform all the operations on the other end. Two machines could outperform the ten or more conventional lathes in the machine shop; quality would be much better; and cutting fluids could and should be used.

Oberserved Results and Company Reactions

The consultant was very well received by the company's management. They discussed the problems at length with as many as four of the managers taking part at a time. They appeared to understand and agreed with the consultant on all of the issues. They were disappointed that the consultant and Sandvik both disapproved of their sharpening the disposable extractor drill tips,

and they will probably continue to try and sharpen them. They do intend to purchase a drill sharpening grinder as soon as possible. Hopefully, they won't allow price to be the sole determinant and they'll buy a good product. They won't even attempt to use cutting fluids on their lathes.

DELIVERABLES TO KYUNG-IL PRECISION COMPANY

Problem B1. They are turning forged alloy steel and getting continuous chips. They need to know how to contend with these chips.

1. "Designed-in Chip Control," D.J. Weller, Tooling and Production, February 1980, pp. 92 & 93.

2. "On the Mechanism of Chip Breaking," S. Kaldor, A. Ber, and D. Linz, Journal of Engineering for Industry, August 1979, Vol 101, pp. 2 & 1 - 2 & 5.

Problem B2. The company desires to reduce machining time.

3. "Choosing the Right Carbide Insert," Eugene H. Sanders, American Machinist, April 1982, p. 139.

4. Description of Upset Forgings.

5. "Research Goals in High Speed Drilling," G.H. Kahng, Society of Manufacturing Engineers, Technical Paper.

6. "Cutting Speeds & Feeds," Machinery's Handbook, pp. 1744-1780.

Problem B3. They are drilling with a multiple drill head and using a drilling jig which quickly wears out, resulting in out-of-tolerance hole patterns.

9. Brochure on the "Optima" drill grinder.

Problem B4. Company needs specifications on sharpening the Sandvik extractor drill bit.

10. "Drilling Systems/Tools and Inserts," Sandvik Coromant.

Problem B6. The company wants to know if they should use cutting fluids in cutting forged steel with carbide tools.

11. "Cutting Oils and Compounds," Machinery's Handbook, pp. 1826-1833.

12. "Cutting and Grinding Fluids," Tool and Manufacturing Engineers Handbook, pp. 2-1 through 2-19.

13. Cutting Fluids Improve Tool-Life of Carbide Tools by Chemical Reactions, W. Konig and N. Diederich, Laboratorium fur Werkzeugmaschinin und Betriebslehre der Technischen Hochschule Aasken.

14. Cutting Fluids Increase the Life of Cemented-Carbide Face Mills When Milling Chrome-Nickel Alloy, N.I. Tashlitskii, Vestnik Moshinoshoeniya, Volume 61, Issue 4, 1981, pp. 43-44.

Problem B7. They needed general ideas of methods and equipment to check surface finishes other than visual comparison.

15. Brochure on Mitutoyo Surftest III.

16. Laser Scanning for Defects, Dimensions and Surface Finish, G.M. Clarke & J. Bedford Ferranti Limited, Dalkeith, Scotland.

17. Ein Oberflachenprufgerot mit Piezoelektrischen Fuhler, H. Wolf, Werkstatt und Betrieb.

Problem B8. They needed a better method for single point cutting of threads.

18. A collection of specification sheets on various types of thread cutting, single point tool, and machines.

Dong Sung Development Manufacturing Company, Ltd. (Company D)

Dates Visited: May 19 and 31, and June 13, 1983
KCGF Staff Involved: Mr. Shin, Jung Sup
Principal Products: Automotive clutches and stamping presses

Previously Observed Problems or Questions

The company was interested in a replacement material for asbestos in its clutch and brake products and wanted information on appropriate materials. The company wished to be informed of current regulations in the U.S. regarding the health hazard of asbestos in the factory and in end products. The company wanted information on the replacement clutch market in the U.S.

The second series of questions pertained to stamping presses. The company wanted information on press automation, especially where robots were employed. The company requested information on safety standards that apply to presses sold in the U.S. Lastly, the company wanted information on the stamping press market in the U.S.

Observed Problems or Questions During the Current Period

During the consultant's presentation of substitute materials for asbestos, the company's engineer requested that preliminary cost figures be developed comparing these materials with asbestos.

The stamping press factory is crowded with work-in-process. Carrying excessive inventory is a strain on the profitability of the company, and it is difficult to work in a crowded workplace.

Actions During Current Period

The consultant reviewed nine pieces of research material relating to asbestos, asbestos substitute materials, and safety and health regulations concerning asbestos use. The consultant presented information on the world production of asbestos and the demand patterns. The grades of asbestos mined in Canada and their prices were included in this information. The location and types of mines in the U.S. were given as was the information for Canadian mines, also including mill capacity.

Several articles specifically addressing asbestos substitutes were reviewed with the company. These presented the candidate materials: fiberglass, ceramic fibers, aramid fibers, silicone rubbers, mineral wools, graphite fibers, calcium-silicate boards, and silicate fiber boards. He discussed the attributes of these materials in relation to these applications in replacing asbestos. Several U.S. sources of these materials were identified: Dow-Corning, Ownes-Corning, Corning Glass, DuPont, Pyrotek.

The consultant's preparatory research caused him to conclude that aramid fibers are the best asbestos replacements in brakes and clutches. He contacted DuPont and requested information on their Kevlar aramid filler, which he delivered and reviewed in detail with the company. Kevlar has high strength, high resistance to wear, nonabrasiveness, and very good high temperature performance. Kevlar is supplied in continuous filament fiber, pulp, and chopped fiber. The continuous filament fiber is generally used in clutch facings.

The consultant cautioned the company that Kevlar required special processing; the tough fibers do not break up during mixing, forming clumps or poor dispersion. This reduces efficiency of the reinforcement of the material and can lead to locally weak areas which fail in molding or machining. Regarding the cost effectiveness of Kevlar, the consultant did not have actual prices of the material; however, he did review a cost effective analysis with the company based on the relative costs given in the research materials. Such cost comparisons are not as trivial as comparing the cost of two materials on a weight basis. For example, the cost of Kevlar, on an equal weight basis, is more than ten times that of asbestos. But, the aramid is stronger and has a density which is less than half that of asbestos. Therefore, a smaller amount of the aramid will provide as good reinforcing characterizing as a given weight of asbestos fibers.

In one application, it was possible to replace 20 pounds of asbestos with 1 pound of Kevlar plus 19 pounds of inexpensive inorganic fillers. The result was an asbestos-free product that costs about the same as the original asbestos-containing product. Thus, the consultant suggested that a rule-of-thumb for break-even cost between asbestos and Kevlar is the replacement proportions of 1 to 20. However, the company should be mindful that the wear resistance of the

Kevlar containing product is two to three times that of the asbestos-containing product. Since wear is of paramount importance in clutch facings, the Kevlar-reinforced facing should be able to obtain quite a large price premium. Should the company wish to pursue Kevlar further with regard to price quotations or further technical information, they can contact the consultant's source, R.V. Michum at (302) 994-4213, or John C. Norman, who is a marketing specialist in Kevlar at E.I. DuPont, Wilmington, Delaware, U.S.A.

In answer to the company's request for information on current regulations in the U.S. on the health hazards of asbestos in the factory and in end products, the consultant delivered the OSHA regulations regarding asbestos exposure, research results from brake emissions studies, and his summary of the situation which was acquired from secondary sources and knowledgable individuals. OSHA is active in forcing replacements and checking to determine if air standards of two fibers per cubic centimeters of air are being met in work areas. Industry's reactions are mixed. Many plant managers say they will continue to use asbestos until they are forced to replace it by some outside agency. Some want to replace it only if costs of replacement materials are in line with present costs. Others want to get rid of asbestos regardless of the cost consequences.

Public pressure has forced the discontinued production of many asbestos-containing items and is forcing asbestos replacement in other necessary items. With regard to the items of interest to the company, brakes and clutches, many research projects have attempted to quantify the health hazard due to asbestos. The results are mixed, and the U.S. government has not enacted any ban on asbestos use in brakes and clutches. The knowledgeable sources contacted were unable to say if or when such a ban would be enacted. Some U.S manufacturers are currently moving to asbestos-free clutch and brake facings, as are European manufacturers. The consultant showed the company a news release from Saab stating that asbestos-free disc brakes are standard equipment on all their 1983 models. This may be a precursor of things to come.

The consultant reviewed an excellent recent article entitled, "The Basics of Press-Feed Automation," with the manager of press manufacturing. The consultant covered when to use cradles or reels with coiled stock, if reels were indicated; when to use power reels, and what types of mechanisms and controls

were appropriate for different situations. He reviewed straighteners, the different types and their relative capabilities. Then he covered combinations of coil handling and press feed equipment, their relative speeds and tolerance capabilities as well as their set-up procedures and set-up speeds. The manager acknowledged that he knew a great deal about press feed equipment because his company made several items in this line, but he had never been exposed to such a comprehensive overview of press feed automation from a user's point of view.

The consultant had witnessed a demonstration of robots specifically designed to feed stamping presses at the recent Auto Fact IV exposition. He requested information from the manufacturer, Minster Corporation, and reviewed this material with the company. This robot system fills the gap between transfer/progressive stamping and single unit stamping. The robots can be used with any make of press and provide totally automated operation from stock feeding, through any number of stamping operations, to finished parts handling. The robots can also reorient the parts between operations. The system provides á level of automation and flexibility formerly unavailable at any price. The consultant encouraged the company to contact Minster to see what arrangements could be made to market their presses with the Minster robots in Korea and Asia. The consultant also presented the company with brochures on Praab and Felsomat robots. These are simple robots generally used in stamping applications; they are not as specialized as the Minster robots.

The consultant reviewed "Power Press Safety Manual" with the company. This manual is over one hundred pages long and is published by the National Safety Council. It is a very concise and useful guide to press and die safety design. The consultant reviewed major topics. The manager wanted to study this in detail and requested that the consultant try to get an original copy of the manual for the company's use, because the photo copy was inconvenient for repetitive use and not durable enough.

To satisfy the company's request for market information on both automotive clutches and power presses, the consultant presented materials taken from U.S. Industrial Outlook 1983. The pertinent sections were on motor vehicles and machine tools and accessories, respectively. In both cases, statistical trends were shown from 1972 to the present and projections were

made for 1983. The consultant instructed the company representatives on the items covered in the statistics and how to interpret the tables, and reviewed the important text passages in the material.

The consultant's observations on the excessively large amount of work-in-process inventory in the plant were acknowledged by the plant manager. There are extenuating circumstances accounting for the large WIP: the machine tools employed are old, conventional tools requiring extensive set-ups; they are not flexible enough to allow streamlining of the workflow. Also, the supply of parts and materials are sporadic, causing production delays and set-asides. These circumstances may indeed be the overriding cause for the large WIP, but the magnitude of the funds involved should encourage the company to adopt a very effective scheduling and job order control system in this instance, even a computerized system running Materials Requirements Planning (MRP) software might be justified.

Future Company Requirements

The company requested that the consultant promote their clutch manufacturing capability to U.S. customers when and where appropriate. The company may require follow-up assistance in dealing with DuPont in regard to Kevlar. The consultant will acquire an original copy of the "Power Press Safety Handbook" for the company's use.

Observed Results or Company Reactions

Both the managers of the clutch plant and the stamping press plant were well pleased with the assistance provided. The second visit was made exclusively to the clutch plant and the third visit to the stamping press plant. In each instance the manager was initially skeptical regarding the value of the assistance and resentful of the interruption. However, both managers became intensely interested once the session was underway and the sessions ran well past their allotted times. Both managers were degreed engineers who had studied English language textbooks and had spent time in the U.S., so the burden of language translation was not great. The sessions moved briskly; there was a lot of material to cover. The managers made a conscious effort to communicate directly with the consultant in English which, judging from experience, they

would not have done if they did not value the assistance. The materials and information provided were very valuable to the company and almost impossible for the company to have acquired on its own. Also, all of the assistance has a direct impact on the current or near future operations of the company.

DELIVERABLES PROVIDED TO DONG SUNG DEVELOPMENT MANUFACTURING COMPANY, Ltd.

Problem D1 and D2. The company requested information on clutch facing materials and would like to be made aware of the current trends in the U.S.A. in regard to the use of asbestos materials in clutch and brake linings.

High Temperatures," Dale C. Swanson 1980, pp. 36-30.

plications in Transportation," John C. and Development, July 1981, pp. 105-

es for Brake Pads and Clutches," Harry V. Kubczak, Society of Automotive eting, June 1979, 8 pages.

Substitute for Asbestos," E.I. DuPont de 531, 1/81.

" Ronald L. Williams and Jean L. cience Department, General Motors 2, 1981, pp. 70-82.

Saab Motors new release in Machine

Tough Applications," David. T. Curry, pp. 32-55.

the textbook Engineering Aspects of 3.

on of the U.S. Occupational Safety and 8 pages.

uested information on U.S. clutch

Projections)," U.S. Industrial Outlook

sted information on press automation h standard stamping presses.

omation," Edward Walker, American -120.

12. Minster/OR11, "The New Age of Press Robotics," Bulletin 102, The Minster Machine Company, 11 pages.

13. Publication Order Form, American Metal Stamping Association, November 1982.

14. Prab & Versatran Robots, Prab Conveyors, Inc.

15. ARMAX Robots, Planet Corporation.

Problem D6. The company requested information on U.S. stamping press market.

16. "Machine Tools & Accessories (Trends and Projections)," U.S. Industrial Outlook 1983, pp. 20-1 through 20-3.

Sam-U Dies Machinery Manufacturing Co., Ltd. (Company E)

Date Visited: May 23 and June 6, 1983
KCGF Staff Involved: Mr. Shin, Jung Sup
Principal Products: Molds for plastic injection molding

Previously Observed Problems or Questions

The company needs technology to mold computer keyboard keys. These keys have molded in figures of a different color plastic from the body of the key.

The company needs to know how to engrave dies with figures and letters. There are two specific problems:

(a) Keyborad keys are concave on the top. The company engraves dies by using a pantograph type engraving machine which works on a flat surface.

(b) They use a milling cutter engraving tool and this leaves edges and corners that must be subsequently cleaned up by hand. The company needs a better technique and/or equipment.

The company also requested general assistance in terms of a technology audit and an operations audit.

Observed Problems or Questions During Current Period

No new problems or questions were tendered during the initial visit. However, clarification was gained on the prelisted problems.

The company's technology needs with regard to the design and tooling of molds for two-color keyboard keys go beyond the conventional techniques for two-color molding. They are interested in making tooling for a special type of low profile key for a particular customer. The tooling is sculpted and canted so that the geometry of the key makes the design of cores and slides for the mold practically impossible. However, the company did not have the final specifications on such a key.

Action During the Current Period

The consultant reviewed material on two-shot moldings and co-injection moldings. These two processes are the conventional methods for making two

plastic or two-color parts. However, this information was not new to the company. The company's requirements for design tooling for a proprietary key design was the major concern. The consultant could not supply information on this specific design, because the method is proprietary and not in the public domain. The consultant and the company could only discuss possible methods, and no significant progress was made in formulating a workable design. The company admitted that they did not expect to get the solution to this problem from the GIT consultant. It is a very difficult problem whose solution has defied many experienced mold designers. They were taking a long shot chance that the GIT consultant might happen to know the alleged Japanese mold design strategy which produces the sculpted and canted keys.

Regarding the company's need for better methods to engrave numbers and figures on irregular surfaces, the consultant delivered specifications on four different types of equipment. The three dimensional pantograph copy mill is capable of this task, as is the CNC milling machine while executing specialized sculpted surface NC programs. However, both of these devices use conventional milling cutters, so no matter how small the cutter, some hand work is required to clean up the ridges and rounded corners. The consultant suggested electric-discharge milling (EDM) as an alternative. EDM is widely used where complex internal shapes are desired that would be impossible to produce by conventional machining. The consultant also suggested wire EDM. Wire EDM is finding many uses in the production of dies and molds and is capable of producing complex multi-axis cuts and exceptional surface finishes, both of which are very important to mold makers. The only drawback of wire EDM is that it requires a through hole. However, there are methods to construct the mold by laminations and cores so that wire EDM can be used in many instances which at first seem implausible. The company was enlightened, but somewhat disappointed that there was no quick and inexpensive solution to their problem.

In responding to the company's request for general information on die-making technology and management techniques, the consultant delivered articles on a range of pertinent subjects. The consultant is very familiar with the problems of managing a job shop operation. He sympathized with the company on problems concerning the control of work flow and the assurance of quality. Every job is different and there are many opportunities for mistakes. About the

only way to handle this type of operation is to install a rigid job order system and acquire the services of an experienced production planner. The consultant gave the company a copy of "Four Steps to Better Tooling" by Carpenter Technology Company. The company manager said this would be very useful. The consultant also showed the company a technique to make prototype molds that could be used for production. Also, the consultant explained how Computer Aided Engineering (CAE) is revolutionizing the mold making industry and urged the company to keep abreast of developments in CAE because they must consider employing CAE in the near future if they are to continue to compete in this industry.

Future Company Requirements

No further assistance required.

Observed Results and Company Reactions

This company is fairly advanced in its knowledge of mold making. The amount of work underway and the size and complexity of the molds tend to substantiate this. In fact, this company makes molds for enclosures for Televideo Corporation, which is a fairly large U.S. manufacturer of terminals and microcomputers.

The company of its own admission was looking for highly specialized and/or proprietary techniques or new ways of cutting metal which are very inexpensive and currently nonexistent. This is a highly speculative approach to receiving assistance from a consultant with general experience and limited time. There are undoubtedly many areas needing information and explanations in the company which the consultant could have addressed very effectively. The priority item was wasted on a "needle-in-a-haystack" type problem and the last problem is simply a safety net to catch some useful information from the assistance. Fortunately, the consultant did have some useful research information and a familiarity with the company's type of business or else the assistance would have been of no benefit.

DELIVERABLES PROVIDED TO SAM-U DIES & MACHINERY MANUFACTURING COMPANY

Problem E1. They needed to know how to make computer keyboard keys.

1. "Conjection Molding," Kurt Alex, Modern Plastics Encyclopedia 1982-1983, pp. 316-317.

2. "Selecting the Right Keyboard," Rand J. Eikelberger, Machine Design, November 12, 1981, pp. 68-74.

3. Inductric Keyboards, Keytels Division Electric Corporation.

Problem E2. How to engrave dies with figures and letters. Keyboards are not flat and this pantograph engraving machine works on flat surfaces. How do you get sharp internal corners on figures and letters?

4. Specifications on Deckel and Lars engraving and copy milling machines.

5. Specifications on a large number of Electric Discharge Milling (EDM) machines.

6. Specifications on a large number of Wire EDM machines.

7. Brochures on Ogie wire EDM machines.

Problem E3. General productivity and technology issues related to production of molds for plastics injection molding.

8. "Computer Aided Engineering (CAE) in Plastics: Designing for Production," Structural Dynamics Research Corporation (SDRC) Newsletter, Summer 1982, pp. 1-19.

9. "Four Steps to Better Tools and Dies," Computer Technology Corporation, May 1981, pp. 1-36.

10. "Building Prototype and Production Tooling Simultaneously for Injection Molded Parts," Robert M. Lien, Bell Laboratories.

11. "Rumerless Molds for Engineering Plastics," Thomas M. Roder, E.I. DuPont Neumours & Company.

12. "Inspection of Molds During Manufacture and Use," Kenneth W. Green, IPSCO/ARCONIUM.

13. "CAD/CAM: Helping the Plastics Industry Meet the Challenges of the Future," Ronald D. Gates, Polster Tool Engineering, Inc.

14. "Computer Aided Analysis in Plastics Injection Mold and Part Design," David G. Richards et al., General Electric.

Nae Way Industrial Company, Ltd. (Company H)

Date Visited: May 16 and 26, and June 3, 1983
KCGF Staff Involved: Mr. Shin, Jung Sup
Principal Products: Pumps and Blowers

Previously Observed Problems or Questions

Above air output pressure of 0.5 kg/CM^2; the temperature of the roots blower causes the rotor and housing to come into contact. The company has heard that the Japanese apply heat-treating methods to reduce the thermal expansion coefficients of the cast iron rotor, eliminating this problem. The company requires research data and assistance on this problem.

The company heats the cast iron rotor and presses in steel shafts on either ends of the rotor, which they subsequently machine. The cast iron rotors sometimes crack and the shafts come out during the machining.

The company has very little information on pump design and pump fabrication; they simply copy the designs of others. They are anxious to acquire this type of information particularly on centrifugal pumps applicable to pulp and paper mill processes.

Observed Problems and Questions During Current Period

No new problems or questions were tendered during the initial visit. However, clarification was gained on the first two problems.

The contact of rotor and housing of the roots blower occurs when the blower is cycled on after being off for a while. Thus, the temperature differential between the housing and the rotor is a contributing factor to interference between the two.

The cast iron rotor is heated to 1400°F by direct firing as part of a normalizing process before the steel shafts are pressed in. This has serious implications on the problem.

Action During the Current Period

The consultant extensively researched the problem related to the interference of the rotor and housing of the roots blower. He provided three pieces of research material listed below that are pertinent to the problem. He reviewed each piece in detail with the company, answering all of their questions.

In summary: the coefficient of thermal expansion of cast iron can be reduced by alloying or by alloying and heat treatment. The heat treatment of unalloyed cast iron has little effect on this particular attribute.

There are a number of alternatives suggested in the research material which would suffice; however, the trick is to select the most cost-effective solution. The first article from the Russian source indicates that Titanium has a spectacular effect on reducing the thermal coefficient of expansion. However, the consultant suspects that the titanium alloy will cause the formation of titanium carbide in the iron, thus making it hard to machine. The assumption that small amounts of graphite-formers reduce growth resistance appears to be correct. This is going to require the collaboration of a foundry and some trial and error to get it right, but it may the cheapest method in the long run. The other alloys suggested in the literature are all very high in Nickel content, making them quite expensive. If the company is going to go to this expense, it might as well consider using Nodular Corrosion-Resistant Austenitic Nickel Iron. This iron contains from 18% to 36% Nickel and is treated with magnesium to achieve high strength and ductibility. This iron is nonmagnetic and resistant to frictional wear, corrosion, erosion, heat, and oxidation. Also, this iron responds to heat treatment to include dimensional stabilizing. These irons can be found in deliverable #3 in Table 16. It would be possible to mold the rotor as one piece instead of pressing in the steel shaft ends. A number of heat treatments would be required and should be done in a controlled atmosphere furnace to prevent decarbonizing and scaling. The end product would be excellent from all standpoints, but the cost might be excessive.

The second problem, rotors cracking and shafts coming out after shrink fitting the shafts in either end of the rotor, is related to the first. In fact, the use of Nodular Corrosion-Resistant Austenitic Nickel Iron would eliminate the

shrink fit operation altogether. There are several other alternatives which will be explained after the causes of the problems are diagnosed below.

The consultant carefully questioned the company's engineer about the processing of the rotor. The information had to be gained secondhand as the heat treating and shrink fitting is done at the foundry which casts the rotor. It seems that the rotor is heat treated to relieve the stresses in the as-cost condition. The process involves bringing the rotor to over 1200°F and slowly cooling from there. The steel shafts are inserted at this elevated temperature prior to the cooling down -- hence a shrink fit.

Two possibilities exist here: If the assembly is not reheated to the elevated temperature, the cold shaft will quench the area around the hub and embrittle that area, making it susceptable to cracking. However, if the assembly is reheated to the stress-relieving temperature, the stress of the shrink fit will also be relieved, resulting in a loose fit. Neither of these eventualities is desirable.

The consultant also did some calculations on the tangential tensile stress of the fit (see Exhibit 1). The stress is much too high for the gray iron material. The consultant recalculated using a more reasonable stress limit and arrived at a recommended interference fit allowance. He then calculated the expansion temperature necessary to permit the shrink fit assembly. The resultant temperature is 300°F, which fortunately is below the crack-sensitive temperature for cast iron which is between 400°-700°F. Therefore, the recommendation is to:

1. Reduce the interference fit as shown in the exhibit.
2. Heat the rotor to the stress-relieving uniform temperature of 1200°F, slow cool in the furnace to about 325°F, then insert the shafts and allow to cool to ambient.

The above recommendations should work. The radial force, axial force, and torsional holding power of this fit is calculated in Exhibit 2. The company will have to compare these figures with its specifications on the part and the machining forces involved in machining the shaft ends. If they are not sufficient, the company can increase the length of fit. The consultant does not recommend increasing the interference, as the yield strength of the cast iron will be exceeded. If the holding forces are still not sufficient, the company will

have to change the material of the rotor to a high strength cast iron in order to increase the interference. If a change in materials is indicated, the one piece nodular iron rotor suggested above should definitely be considered.

Other alternatives are possible rather than changing materials of the rotor. An anaerobic adhesive could be used to join the shafts and rotors. The U.S. company LOCTITE makes such an adhesive. The only reservation the consultant has is whether the adhesive can withstand the heat cycling of the blower. The consultant provided information on the LOCTITE company. Welding the steel shafts to the cast iron rotor is possible, but it is difficult and unpredictable. Mechanical fastening with dowel pins and bolts is also a possibility, but the extra machining operations required would be expensive. Also, care must be taken that the fasteners do not loosen from vibration or heat cycling during the operation of the blower because this could be disasterous in this piece of high speed machinery.

The third requirement of the company, design methods for centrifugal pumps to handle pulp mill products and information for impellers and volute casings for different density products, was satisfied by the transfer of materials from the Pump Handbook and other current sources, as listed under the deliverables section. The consultant reviewed these materials with the company, pointing out the most important considerations, most notable of which were the new trends in centrifugal pump toward higher speeds and fewer stages, the use of inducers, and new materials such as Compacted-Graphite Iron. The company was delighted with the information from the Pump Handbook and wanted a copy of the handbook. The consultant loaned the company the copy he had brought, which belongs to the GIT Library. He notified the project director at GIT of the company's request, and a copy of the handbook was immediately sent for the company's permanent use.

Future Company Requirements

All company requirements were satisfied during the GIT consultant's tour in ROK.

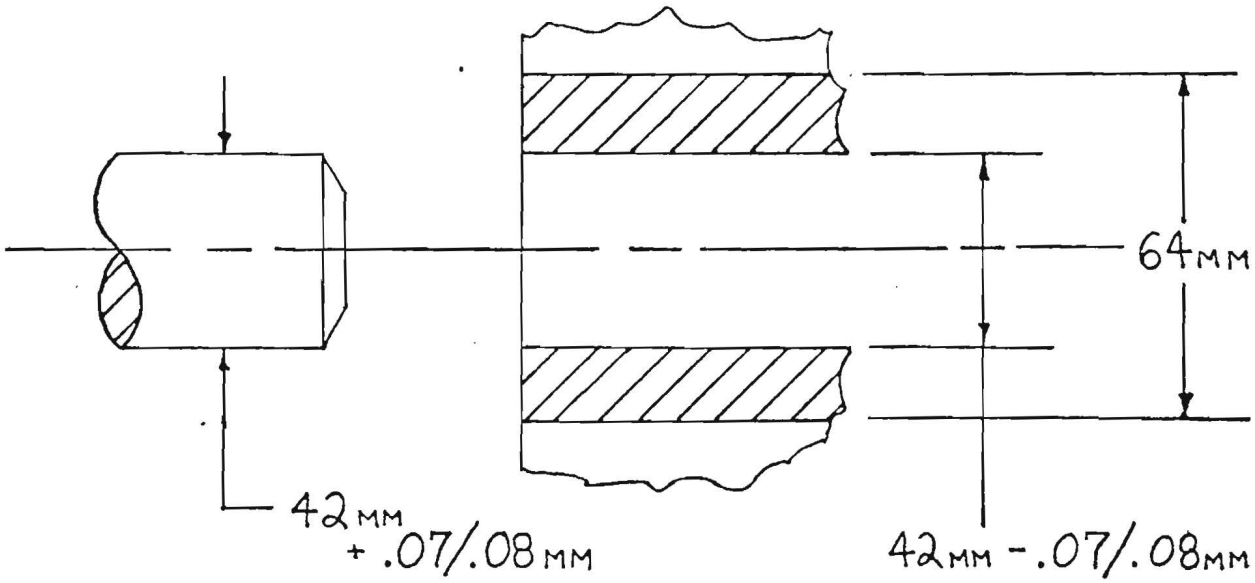
Observed Results and Company Reactions

The company was very enthusiastic about getting the assistance and will

implement the consultant's recommendations. The management of this company is young, energetic, and progressive. Also, the company appears to be well positioned in the pump and blower business in terms of market and equipment. The apparent shortcommings of the company are lack of space and rather primitive assembly techniques. These conditions are most prevalent with the small to medium-sized ROK companies and will take time to improve.

Calculations Based on Shrinkage Fit
Section in Machinery Handbook
pp. 1544-1552

Existing Situation



Maximum Interference is 0.16 MM
in inches - .0063 in.

Fit Allowance is .0038 IN/IN or MM/MM

$$A = \frac{T(2 + C)}{30 \times 10^6}$$ (For cast iron hub and steel shaft)

Ratio of Diameter = 64/42 = 1.524

From Table I. C = .237 (by interpolation)

Solving for T (true tangential stress)

$$T = \frac{A * 30 * 10^6}{2 + C} = \frac{.0038 * 30 * 10^6}{2.237}$$

$T = 50{,}961$ psi

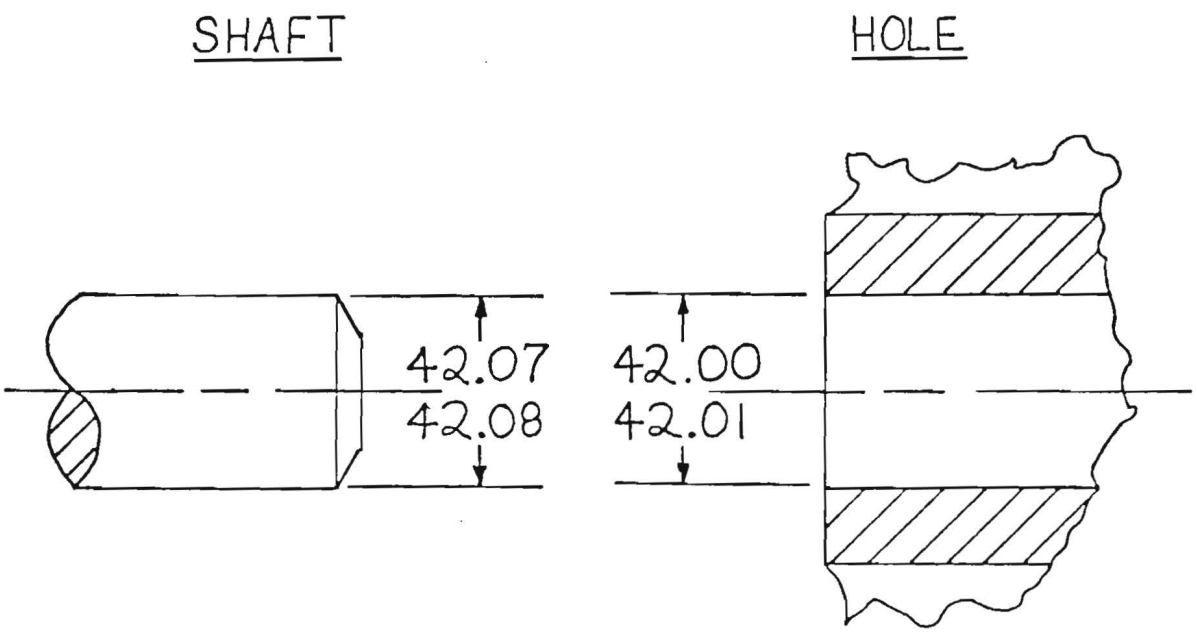
But T is too high for gray cast iron. The tensile strength of cast iron is only 30,000 PSI. This would have to nodular iron, and it is not. Therefore, we must use a smaller shrink allowance.

HMIT T To 25,000 psi.

$$A = \frac{25 \times 10^6 (2.237)}{30 \times 10^6} = .00186$$

Therefore, the maximum interference is .078 MM. We can stretch this to .08 MM.

Recommended Shrink Fit Dimensions
and Method of Drawing Notation



This type of notation is easy for the machinist to interpret and the limits of the force/shrink fit can be easily seen.

Now to determine the temperature for the shrink fit. The coefficient of expansion for cast iron is $6.2 * 10^{-6}$ N/IN-°F.

$$t = \frac{0.00186}{0.0000062} = 300^{\circ}F$$

Calculations Based on Shrink Fit Section in
Tool and Manufacturing Engineers Handbook

Radial Pressure:

$$P = E \frac{(b^2 - a^2)(c^2 - b^2)}{2b^3 (c^2 - a^2)}$$

$$= \frac{16 \times 10^6 * .0016 * (.8268)^2 * (.4331)^2}{2 (.8268)^3 . (1.2598)^2}$$

$$= 1830 \text{ psi}$$

Axial Force:

Length of the fit was estimated at 2 inches. The consultant does not have exact measurements on the length.

$$F = 2L\, bPf$$
$$= 2.2 * .8268 * 1830 * 0.2$$
$$= 1210\#$$

Torsional Holding Power:

$$T = 2\, Lb^2 Pf$$
$$= 2.2\ .8268^2 * 1830 * 0.2$$
$$= 1000\#$$

DELIVERABLES PROVIDED TO NAE WAY INDUSTRIAL COMPANY

Problem H1. Different cool down rates of the rotor and housing of a roots blower product causes the rotor to contact the housing. The company requires information to reduce the thermal expansion of cast iron.

1. "Growth Resistance of Cast Iron for Enamelled Castings," translated from Liteinoc Proizvodstvo (USSR), 1974.

2. "Structure and Properties of Austenitic Nickel Cast Irons," L.I. Aptekar & Y.A. Abramenko, Translated from Metallovedeniee i Termicheskaya Obrobotka Metollov (USSR), No. 4, pp. 28-40.

3. "Heat Treating of Cast Irons," ASM Committee on Heat Treating of Cast Irons, pp. 203-220.

Problem H2. They heat the cast iron rotor of the roots blower and press in steel shafts on either end, which they subsequently machine. The cast iron rotors sometimes crack or the shafts come out during machining.

4. "Shrinkage Fits," Machinery's Handbook, pp. 1549-1553, 1558-1559, 1566-1567.

5. "Shrink and Expansion Fits," Tool and Manufacturing Engineers Handbook, pp. 27-50 thru 27-57.

Problem H3. They require design methods for centrifugal pumps to handle pulp mill products.

6. "Centrifugal Pump Theory," Walter K. Kekot, Pump Handbook, 1976, pp. 2-1 thru 2-30.

7. "Centrifugal Pump Construction," Igor J. Karassik, Pump Handbook, 1976, pp. 2-31 thru 2-62.

8. "Pulp and Paper Mill Service," J.F. Giddings, Pump Handbook, 1976, pp. 10-108 thru 10-123.

9. "The Centrifugal Pump of Tomorrow," Igor J. Karassik, Mechanical Engineering, May 1982, pp. 41-45.

10. "CGI: A Cast Iron Reborn," John A. Vaccari, American Machinist, October 1981, pp. 156-159.

Sam Yang Heavy Machinery Company (Company K)

Dates Visited:	May 24, June 7, and June 10, 1983
KCGF Staff Involved:	Mr. Shin, Jung Sup and Mr. Min, Kung Sup
Principal Products:	Iron casting, metal fabrication, and machine shop contract work

Previously Observed Problems or Questions

The company prelisted ten problems or questions. The priority requirement was to obtain information on methods to perform welding repairs on large iron castings. They were interested in methods to relieve the stress in large structures which were fabricated by welding. The company had tried to implement "Full Mold Casting" with marginal success, and requested information and assistance to produce quality casting from the full mold method. Next was a number of related requests that concerned metallurgy and/or heat treating of cast iron material or products. Some items of interest were 50,000 psi gray cast iron and 60,000 psi ductile iron, maleable iron, chill rolls, and new materials. The final concern related to machining of cast iron especially chill rolls.

Observed Problems or Questions During the Current Period

The company preselected many questions which were still of interest, so no new questions were tendered. However, the company has some specific requirements for information relating to the original questions which were brought out in the consultation sessions.

The water soluble, silica-base, refractory material which is applied to the full mold pattern is critical to the success of the full mold casting process. The company requested that the consultant contact a likely source of this material for possible use by the company.

The consultant's introduction of a new Silicon Nitride ceramic cutting tool was of keen interest to the company, and they asked the consultant to try and obtain a sample insert for their trial.

Action During the Current Period

The consultant spent several hours instructing the company president and two chief engineers in the proper practice of welding cast iron. He supplied the company with five separate articles/research materials on the subject. The most valuable of which was an article in American Machinist, November 1982, simply titled "How to Weld Cast Iron."

Most of the problems in welding cast iron are related to structural changes caused by heating and cooling during the welding process. Stress cracking in the area adjacent to the weld is common and the formation of iron carbides makes the welded area difficult or impossible to weld.

The consultant explained peening the weld as a method to prevent stress cracking. It is a standard practice to peen all but the first and last welding pass.

He stressed that cast iron has a crack sensitive temperature range of 400° to 700°F. He outlined a quick and inexpensive method to perform welding repairs on cast iron that will not require machining. The method is referred to as welding "cold." A single short pass (4 inches long for example) is made and quickly peened while hot. Then adjacent areas are cooled with an ice bag held against the weld deposit and/or an air blast. This permits the weld to be completed in small weld increments and the casting is never allowed to reach the crack sensitive range of 400° to 700°F.

It is most difficult to produce a weld in cast iron that can subsequently be machined. Proper selection of an electrode is paramount. There are 10 or more modern types available for cast iron repair, and each is suitable for a little different purpose. It is usually necessary to experiment to get the right match. Modern electrodes for cast iron repair have the following characteristics:

Weld all cast irons,
Are completely machinable,
Have extraordinary strength,
Have at least double the elongation of nickel-type electrodes,
Have a coating that enables them to bond dirty cast iron,
Are highly crack resistant,
Can join steel to cast iron,
Can be used successfully on both thick and thin cast iron,

Are a good color match to cast iron, and

Weld in all positions.

Proper surface preparation is a must. Clean and degrease the part. Remove all sharp edges or rough areas and corner edges by grinding. File the areas that have been ground to remove the graphite smeared on the surface by the grinding wheel. Sear the surface with an oxycetylene torch with a large tip and a highly oxidizing flame to loosen and dislodge remaining surface graphite.

Several guidelines specify proper welding techniques: Do not weld over sharp edges, threads or other irregularities. Do not strike the arc directly on the cast iron surface; instead, initially strike on a small piece of steel placed adjacent to the weld location and subsequently on previously deposited metal. Do not focus the arc directly on the cast iron. Once the weld deposit has commenced, the electrode should be held at an angle of 30° from perpendicular in the direction of the travel. The idea is to deposit the weld material as quickly as possible. The largest electrode diameter possible should be used. This minimizes the amount of heat introduced in relation to the large volume of weld metal deposition. Contrary to practice when welding steel, weld penetration is not desirable when welding cast iron.

Although not listed as such, the consultant considers "Full Mold Casting" to be of great importance to the company. The company casts dies for stamping automotive sheet metal parts. Many are one-of-a-kind castings. It is very economical to make these patterns in styrofoam and subsequently employ full mold casting to make the part. This is the major advantage, but there are others. Namely, the process requires no heavy equipment, pits, sand mullers, heavy duty shakeout, bottom boards, flask maintenance, or molding machines.

The company is presently employing a modified version of the full mold process which, in reality, isn't full mold casting at all. They use the styrofoam pattern, but they use bonded sand and conventional cope and drag techniques. The styrofoam pattern is laboriously removed from the mold by cutting it up and picking it out in small pieces. This requires delicate surgery because the mold cavity can be damaged very easily and you don't get a second chance to remake the mold because the pattern is destroyed.

Although some full mold castings are made in bonded sand, the conventional practice is to use unbonded sand. The pattern is coated with a water soluble, silica base, refractory material, which is applied by dipping, brushing, or spraying. The coating must have a high gas permeability to permit vapors from the polystyrene to escape rapidly during the pouring cycle. These coatings have been developed specifically for the lost-foam process and, in some cases, are proprietary. The company uses bonded sand; their experience shows that unbonded sand collapses as the pattern evaporates. However, the company doesn't have the correct refractory coating for the pattern. Properly done, the casting is not actually made in the sand, but rather in a ceramic coating surrounded by the sand; the combination of gas pressure developed by the evaporating pattern and the instantaneous replacement of the pattern by the molten metal prevents collapse of the mold walls. The consultant was not previously aware of the specific need for the brand name or recipe for this refractory material. He will make some inquiries to likely sources in the U.S. for this information upon his return.

The consultant discussed gating and venting of the molds with the foundry manager. There was information in the research materials which may help the company perform full mold casting in the interim prior to acquiring the correct refractory material. Permeability may be a problem with the bonded sand. The flask sides should definitely be vented and they should try perforating the sides of the mold with spikes that extend almost into the styrofoam pattern. This will increase permeability.

The company's problems with stress in large structures due to welding can be minimized or solved by uniform welding and slow cooling of the weld and adjacent areas. Fortunately, the structures welded by the company are predominantly cylindrical and the welds are peripheral. The structures can be turned on a cradle or an arbor, while the weld is made by an automatic welder, preferably submerged arc. At the same time, a series of natural gas or LP gas flames can be directed on the recently welded area to prevent rapid cooling by the quenching effect of the massive structure. The set-up is fairly easy after the problem of rotating the large structures is solved.

The company's economic problems with casting large parts and its dilemma over casting methods and mold materials was far too broad in scope to be covered during this brief field visit. The consultant's treatment of full mold casting was very crucial to this overall problem and may, in fact, be a panacea. The consultant provided the company with relative cost and design features of the various conventional casting processes. He also provided handbook listings of a great many molding materials and their attributes.

Two new iron materials were introduced to the company. The first was High Sulfur, Wear Resistant Iron. The attention devoted to sulfur was historically concentrated on eliminating or at least limiting it. Electric furnaces make it possible to attain very low levels of sulfur, .03% or less. However, it was learned that operating at this level leads to excessive scrap loss due to spiking and shrink defects, so the desirable level is in the range of .08% to .12%. This use of sulfur as a process alloy has no appreciable effect on the performance of the casting. Early experiments with higher levels of sulfur resulted in foundry problems and poor machinability, so no production was realized. As a result of recent research, the quality problems have been corrected, and high sulfur, wear-resistant iron has become an important material for a variety of automotive and industrial applications.

In certain applications, no other material can match its wear resistance, and its only alloying element, sulfur, is inexpensive and abundant, in sharp contrast to the alloys used in other wear-resistant materials. The only drawbacks are the tight process control necessary for its production and the need for annealing, which increases energy requirements relative to nodular or alloyed gray iron.

The consultant provided the company with a comprehensive research article on sulfur-alloyed iron, which explained: the processing; the current application; the wear resistance; production practices (charge makeup, meltdown, superheat and pour, molding materials, pattern shrink, and annealing time); mechanical properties; and hardenability.

A second material introduced to the company was Compacted Graphite Iron (CGI). This material was once cast aside as a failed attempt at making nodular iron, but it is now emerging as a most useful material, superior in some

ways to gray iron and in other ways to nodular iron. The consultant provided information on the latest treatment in CGI production, the mechanical properties of CGI, machinability of CGI, and the current applications of CGI.

The consultant provided an excellent article on chill microstructure of cast iron hot strip mill rolls to satisfy the company's desire for information on the variables in producing chill rolls which was highly technical and informative research material from the research laboratory of the U.S. Steel Company. In the article, two hot strip mill work rolls, a nickel-chill iron, and a grain iron type, were investigated to determine and contrast the microstructural features of each.

The consultant provided the company with the entire section on heat treatment of cast irons from the Metals Handbook. He reviewed the high points with the company's foundry manager and circled and highlighted passages that were most applicable to the company's operation.

The company was interested in guidelines and modern methods to machine cast iron, especially chill rolls. The consultant provided and reviewed a January 1983 article in American Machinist on silicon nitride ceramic cutting tools capable of machining cast iron at speeds as high as 5000 sfm. Earlier ceramic cutting tools had a poor reputation due to problems of edge-chipping and catastrophic failure. However, this new Silicone Nitride ceramic is very tough and has a high resistance to both thermal and mechanical shock. The company was very interested. The consultant agreed to help obtain a sample insert. The cutting tools are manufactured by GTE and are marketed under the trade name "Quantum 5000."

Although the ceramic cutting tool above has some spectacular performance statistics on gray cast irons, a material very easy to machine, its performance on chill roll material is questionable. In contrast to gray iron, chill roll surfaces are very hard to machine because they are hard and abrasive, and to complicate matters, they have random spots that are extra hard. This means tool chatter even on new rigid lathes, and the magnitude is worse on old, worn lathes.

The consultant advised two means to reduce the company's troubles in machining chill rolls. First, he provided the company with the "so called" Tumpane Standards, which provide a test pattern for analytical inspection of

heavy engine lathes. Then he recommended that the company consider using high speed tool steel cutting tools instead of carbide cutting tools. The reason for this is that tool chatter causes catastrophic failure of carbide tools, whereas there are special high speed tool steels which survive very well. The consultant provided a American Machinist special report on selecting tool steels which provides very appropriate guidance and coverage of such subjects as cutting tools produced by power metallurgy (PM) and coated cutting tools.

Future Company Requirements

Two actions are contemplated to further assist the company. In reference to full mold casting, the consultant has reason to believe that Arco Chemical Company supplies the water soluble, silica-base, refractory material which is used to coat the polystyrene foam pattern. He will contact the company to confirm this and, if so, he will attempt to arrange for the Korean company to be provided with a sample of the material and/or a procedure for purchasing it. In reference to the company's interest in "Quantum 5000" silicon nitride ceramic cutting tools, the consultant will contact GTE's Walmet Division in behalf of the Korean company along the same lines as above.

Observed Results and Company Reactions

The results obtained were most gratifying. The president of the company took a very active interest in the consultation sessions. He insisted that the sessions start early in the morning and proceed into the evening. This was very prudent in that there were a great many subjects to be covered, and some were covered in great detail. The highest ranking engineers in the company attended the sessions, with as many as six engineers/technicians attending some of the sessions. The sessions were very effective due to the fact that the engineers devoted considerable time to studying the research material. The president of the company was fluent in English and the managers of the machine shop and foundry were adequate in English. This in itself guaranteed that the information was significant, to the point, and well understood.

This company has a huge facility and a correspondingly large capability. The impact of the assistance received will be correspondingly large in terms of quality and quantity of goods produced, profits generated, etc. In summary, the

assistance greatly advanced the company's capability to weld iron castings, greatly contributed to the company's understanding of full mold casting, introduced new cast iron materials, introduced new cutting tools and a better understanding of traditional cutting tools, and generally advanced the company's knowledge of cast irons and their heat treatment.

DELIVERABLES PROVIDED TO SAM YANG HEAVY MACHINERY COMPANY

Problem K1. The company needs information on repairing defects in large gray iron castings.

1. "How to Weld Cast Iron," Leon D. Richardson, American Machinist, November 1982, pp. 129-133.

2. "Arc Welding of Cast Irons," by the American Committee on Welding Cast Irons, Metals Handbook, pp. 235-237.

3. "Casting Repair Pays Big Dividends for Job Shop," featured article in Welding Engineer, November 1972, pp. 35-37.

4. "Craft the Key to Tricky Casting Repairs," Alan Ailes, Welding and Material Fabrication, April 1980, pp. 165-170.

5. "Awards Spotlight Maintenance Welding," featured article in Welding Engineer, June 1982, pp. 220-221.

Problem K3. The company needs an introduction to and economic data, if possible, on methods to cast large parts.

6. Sand-Mold Casting and Ceramic-Mold Casting," Tool and Manufacturing Engineers Handbook, pp. 21-1 thru 21-15 and pp. 22-1 thru 22-26.

7. Descriptions of Sand Casting, Shell Mold Casting, Permanent Mold Casting, Plaster Mold Casting, and a chart showing design features and cost features of each of these.

Problem K4. The company wants information on full mold casting.

8. "Full Mold Casting Goes Mass Production," Donald R. Dreger, Machine Design, November 25, 1982, pp. 47-51.

Problem K5. The company wants a general update on alloyed iron castings and abrasive resistant materials.

9. "Production and Properties of High Sulfur, Wear Resistant Cast Iron," F.B. Rate, K.H. Lowler, and M.J. Pres, American Foundry Society Transactions, pp. 828-834.

10. "CGI: A Cast Iron Reborn," John A. Vaccari, American Machinist, October 1981, pp. 156-159.

Problem K6. The company wants information on producing "chill rolls." They are experiencing difficulty in achieving repeatability in depth of hardness.

11. "Chill Microstructure of Cast-Iron Hot Strip Mill Work Rolls," Dr. R. Judd, Iron and Steel Engineer, September 1977, pp. 83-88.

12. "Cast Conveyor Rollers with a White Iron Working Surface," V.A. Galkin, Translated from Liteinoc Proizvodstvo, 1974, pp. 40-41 and K-9.

Problem K7. and K9. General information on metallurgy of casting 55,000 psi Cast Iron and 60,000 psi Ductile Iron.

10. "CGI: A Cast Iron Reborn," John A. Vaccari, American Machinist, October 1981, pp. 156-159.

13. "Heat Treating of Cast Irons," American Society of Metals, pp. 203-220.

14. "Specialized Heat Treatments and Mechanized Equipment Expand the Applicability of Ductile Iron," Clinton Preble and Patrick Dirom, Industrial Heating, 1968, pp. 826-836.

Problem K10. The company requests guidelines for maching cast "chill" rolls HRC 56. Introduction to new tool materials. They are having vibration problems using carbide tools.

15. "Damping Vibration for Special Lathes," Dr. Dan DeBra, American Machinist, August 1981, pp. 115-116.

16. "Machine Considerations - Large Lathes," from a lecture by W.E. Cline of the General Electric Company.

17. "New Ceramics Rev Up Cutting Speeds," R.L. Hatschek, American Machinist, January 1983, pp. 110-112.

18. "Guide to Selecting Tool Steels," John A. Vaccari, American Machinist, August 1982, pp. 134-154.

19. "Choosing the Right Carbide Insert," Eugene H. Sanders, American Machinist, April 1982, pp. 139.

General Information:

20. "Power Press Safety Manual," National Safety Council, 1972, pp. 1-101.

Jeil Engineering & Industrial Co., Ltd. (Company N)

Dates Visited: May 18 and 30, and June 14, 1983
KCGF Staff Involved: Mr. Shin, Jung Sup
Principal Products: Gearboxes and gear motors

Previously Observed Problems or Questions

The company wanted instruction in the use of the AGMA gear standards. Next, the company posed a series of questions concerning design calculations. They wanted to learn a way to relate strength of material (yield or ultimate strength) to measured hardness. They wanted methods to calculate gearbox load limits based on gearbox temperature limits. They wanted methods to calculate the lubrication required in a gearbox. They wanted methods to calculate expected noise levels in transmissions. Their last request was for general information on "Novikov" gear design.

Observed Problems or Questions During Current Period

After the consultant instructed the company on the particulars of the newly revised AGMA standards (December 1982), the company requested that the consultant assist them in obtaining a copy for their use.

Action During Current Period

The company's AGMA standards were vintage 1964. The standards have been revised twice since then, most recently in December 1982. This most recent revision, AGMA 218.01, supersedes four previous standards: AGMA 210.02 - Standard for Surface Durability (Pitting) of Spur Gear Teeth; AGMA 211.02 - Standard for Surface Durability (Pitting) of Helical and Herringbone Gear Teeth; AGMA 220.02 - Standard for Rating the Strength of Spur Gear Teeth; AGMA 221.02 - Standard for Rating the Strength of Helical and Herringbone Gear Teeth. Also, 218.01 updates and consolidates the spur and helical gear rating methods in two other publications: AGMA 215.01 - Information Sheet for Surface Durability (Pitting) of Spur, Helical, Herringbone, and Bevel Gear Teeth; and AGMA 225.01 - Information Sheet for Strength of Spur, Helical, Herringbone, and Bevel Gear Teeth. The most significant revision in the updated standard is

its new data for certain modifying factors for allowable stress, such as life factor CL or KL and hardness ratio factor CH. There are many more. The consultant reviewed a recent article entitled, "New Rating Standard for Involute Gears," with several individuals from the company's design section. Several example calculations were reviewed: evaluating tooth load distribution, establishing dynamic factors, computing geometry factors, determining life factors, and accounting for gear hardness. All of these were of concern to the company, and some necessary understanding of the new procedures and inclusion of the new data were transferred to the company. The company engineers were eager to acquire the new standards and requested that the consultant assist them. He wrote a letter in their behalf to AGMA requesting a quote to include the price of the new standards and shipping cost to Korea. The company intends to follow-up with a purchase order and a money order.

To preface his treatment of the company's request for design calculations, the consultant instructed the company that mathematical design formulae for gears and gearboxes included many stress-modifying factors that account for variations among gears regarding load application, tooth size, load distribution, safety factor, reliability, and life. The quantification of these factors is based on theory, empirical data, and practical experience.

The company's request for a method to relate strength of material to measured hardness doesn't have a specific answer. This is especially true in relation to gears, where the material is case hardened. AGMA standard calculations consider this by employing a hardness ratio factor. The factor incorporates much new data which cover many types of steels and irons, their surface hardness and range of allowable stress. To reinforce this lesson the consultant reviewed an article entitled, "Guidelines for Quality Carburized Gearing," which stressed the importance of proper carburizing and hardening of gears, covered material evaluation, data anlysis, and the manufacturing technology involved. The consultant also exposed the company to a new method of gear hardening called "Spin-Hardening," which provides better uniformity at reduced costs.

The next two questions, gearbox temperature and lubrication, are closely related. One cannot very well consider one without the other. Generally,

gearing is designed to have sufficient beam strength, tooth surface durability, and scoring resistance. Breaking and pitting are classic modes of time-dependent fatigue failure; however, scoring is not time dependent and may occur precipitously early in the life of a gearset. Lubrication and temperature are major considerations in rating high speed gearboxes. The company's gearboxes are generally not high speed so their concern in these areas is minimal. In fact, the company finishes its gears by lapping, which is unacceptable for high speed applications. Nevertheless, the consultant reviewed the phenomena of scoring and the methods of calculation using the Critical Temperature Concept and the Minimum Film Thickness Concept. The consultant asked if the company had a copy of the Gear Design Handbook. They produced a reasonably current edition, and the consultant reviewed the section on lubrication which gives some guidelines. Then the consultant reviewed a recent article entitled, "Lubrication Analysis by Computer." It reinforced the consultant's contention that lubricant films are so complex as to defy analytical theory, but it wasn't very useful in practice.

The company's request for methods to calculate expected noise levels in transmissions was handled in two phases.

First, the consultant instructed the company's design engineers in design methods, which resulted in quiet transmissions. He instructed in gearset accuracy and contact ratios, special purpose gearing and materials, multiple power paths and gear mesh phasing, shaft alignment and dynamic bearing loads, and housing design methods and modifications. He provided the group with graphs showing the effects on sound pressure level by employing tooth profile modification, high quality gears, improved surface finish, and increased helix angles. He gave them many easy to apply rules-of-thumb.

Second, the consultant instructed the company's design engineers on methods to minimize noise in existing transmissions. He covered noise isolation, vibration isolation, vibration damping, vibration absorption, and impulse phasing. These methods are not easy to apply, are often expensive, and produce unpredictable results. The consultant stressed that design methods are best for reducing noise in transmissions. The company cannot hope to produce quiet gearboxes with their present methods of design and manufacturing. They will

need to make many changes. The information provided by the consultant will assist the company in making appropriate decisions.

The final request of the company was for information on "Novikov" gearing. The consultant satisfied this request by providing three relatively recent articles on "Novikov" gearing. All of the articles were originally in Russian and were translated to English. After a review of the articles, a general conclusion can be drawn that Nivokov gearing is used in high speed applications where it is desirable to ensure as high a contact strength of the teeth as possible, even at the expense of the reserve of their breaking strength. Much data and discussion regarding Novikov gearing is included in the articles for the company's review. The engineers could not tell the consultant what application they were considering for Novikov gearing. It is presumed that they were just exercising their technical curiosity.

The consultant provided several excellent articles beyond what was required, one on proprietary gearing and two on gearmaking: "Fundamentals of Gear Cutting," and "Gear Cutting with Tin-coated Tools." These are all very appropriate for the company and will be used.

Future Company Requirements

The consultant plans to follow-up to make sure that the company gets its copy of AGMA 218.01. This will be the most important technical source book in the company's library.

Observed Results or Company Reactions

The consultant was pleased with the assemblage of research materials he had prepared for the company. The breadth of the information is very large and the consultant and the company could go into as much depth in any of the areas as possible. A total of fifteen articles were delivered comprising 73 pages. Also, he used the company's old copy of AGMA standards and their copy of the Gear Design Handbook. Most of the subjects covered were ahead of the company's current technology. It is doubtful that they will be able to put half of the information into practice in the near future. However, they are somewhat more enlightened and were very appreciative of the assistance. It would be almost impossible for the company to have collected this information on its own.

Just making the company aware of the newly revised AGMA 218.01 and explaining its new data and methods were of very great value. After the company acquires the new standards and becomes proficient in their use, the company will reach a new level of competence in gear design.

DELIVERABLES PROVIDED TO JEIL ENGINEERING & INDUSTRIAL CO., Ltd.

Problem N1. & N2. The company requires current information, examples, and experience about AGMA standards. The company implied that AGMA standards are too conservative.

1. "New Rating Standard for Involute Gears," Octave A. Labath in Machine Design, April 21, 1983, pp. 55-60.

2. "Forecasting the Machining Accuracy of Gears on the Basis of a Design and Technology Classification," V.P. Ponomarev, Vestnik Mashinostroeniya (USSR), Volume 59, Issue 3, 1979, pp. 28-31.

Problem N3. The company requires information on ways to relate strength of materials (yield or ultimate strength) to measured hardness.

3. "Guidelines for Quality Carburized Gearing, Herbert Hebenstreit, Machine Design, September 9, 1982, pp. 67-70.

Problem N4. The company requires methods to calculate gearbox load limits based on gearbox temperature limits.

4. "Preventing Gear Tooth Scoring, Peter Lynwander, Machine Design, March 20, 1983, pp. 45-49.

Problem N5. The company requires methods to calculate the amount of lubrication required in a gearbox.

5. "Lubricant Analysis by Computer," John K. Krouse, Machine Design, September 25, 1980, pp. 56-60.

Problem N6. The company requires methods to reduce gear noise and/or calculate expected noise levels in transmissions.

6. "Minimizing Noise in Transmissions," Raymond J. Drago, Machine Design, December 11, 1980, pp. 175-181.

7. "How to Design Quiet Transmissions, Raymond J. Drago, Machine Design, December 11, 1980, pp. 175-181.

8. "Gearbox Noise Reduction: Prediction and Measurement of Mesh-Frequency Vibrations," R.H. Badgley and R.M. Hartoran, Journal of Engineering for Industry, May 1974, pp. 567-577.

Problem N7. The company requires information on "Novikov" gear design.

9. "Increasing the Fatigue Strength of the Teeth of High-Speed Reducer Gears with Novikov Gearing," V.A. Pyshkin & J.P. Saigin, Translated from Khinicheskoe i Neftyanoe Mashinostroenie (USSR), No. 11, pp. 32-33, November 1978.

10. "Selection of Basic Profiles of All-Addendum Type Gearing for Novikov Transmissions with Very Hard Tooth Working Surfaces," R.V. Fedyakin & V.A. Chesnokov, Vestnik Mashinostroeniya, Vol. 56, Issue 7, 1976, pp. 20-27.

11. "Helical Reducers with a Novikov Gear for Rocking Machines," M.A. Guseinov et al., Translated from Khimicheskoe i Neftyanoe Mashinostroenie, No. 11, pp. 42-43, November 1975.

General articles provided to the company:

12. "Fundamentals of Gear Cutting," Joseph Jablonowski, American Machinist, Special Report 742, February 1982, pp. 139-154.

13. "Gear Cutting with Tin-Coated Tools," Peter W. Kelly, American Machinist, November 1982, pp. 125-128.

14. "Spin-Hardening Cuts Gear Costs," Joseph Jablonowski, American Machinist, December 1982, pp. 78-79.

15. "Prolem Solving with Proprietary Gearing," Myron Seneczko, Machine Design, April 8, 1982, pp. 63-67.

APPENDIX

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-B- Kung IL Precision Macinery Company Machine Shop Auto & Truck Axel Spindles	5/17 Shin 5/27 Shin 6/29 Shin	1. The company is turning forged steel and getting continuous chips. They need to know how to eliminate or to contend with these chips 2. Need suggestions to reduce machining time. 3. Quicking wearing out drilling jigs and hence parts are out of tolerance 4. Specification to sharpen sandvik BTA drills. 5. Holding tolerance on a 96mmm dia. +0.05 -0.00 x 31 mm length. 6. Is it better practice to use cutting fluids when machining with TIC tools (C + 5 to C-7)? 7. Need a method other than optical comparison to check surface finishes 8. Need better methods or equipment to cut		1. Delivered several current articles on chip breaking and chip control, instructed in proper practice and rules-of-thumb. 2. Many subjects covered and research materials delivered on choosing TIC inserts, high speed drilling, cutting speeds feeds, and modern cutting tools. 3. Common problem in Rok- improper sharpening of drill bits. Explained importance of proper drill bit geometry and provided specs on drill bit grinder. 4. Consultant provided Sandvik BTA catalog. Sandvik does not recommend resharpening, drill tips are disposable. 5. Reject rate is too low to be concerned. 6. Consultant provided articles pro & con. However, after seeing	3. Get prices on drill grinding machine (optima) 2. Contact at Valeron Corp. ROK office	This company has a very simple operation in that they basically do only turnings. They need to consider purchasing one or more CNC turning centers. With turning centers they could combine many operations on one machine. Productivity would be greatly increased and they could use modern cutting tools and cutting fluids. The company was very receptive and plans to buy a drill sharpener and try the consultants recommendations.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-B- Kung IL	5/17 Shin	Threads on axel spindles		The operation the consultant Recommends cutting dry.		
Precision Machinery Company	5/17 Shin 6/9 Shin			7. Provided several alternatives and some specifications thereon. Mitutoyo is offering a device called Surftest III.		
Machine Shop Auto & Truck Axel Spindles	Shin			8. Provided specs on several types of high speed thread cutting machines		

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-D- Dong Sung Devel. Mgf. Company Auto & Truck Clutches and Mechanical Presses	5/19 Shin 5/31 Shin 6/13 Shin	1. Info on clutch facing materials 2. U.S. Regulations and trend toward asbestos use in clutches & brakes 3. Information on U.S. clutch market 4. Information on robot use with stamping presses 5. Safety standards that apply to U.S. presses 6. Marketing information on U.S. stamping presses		1. Many excellent materials delivered and reviewed on asbestos and new materials that will relace asbestos. Specific specs on "Kevlar". 2. Several good research papers reviewed. OSHA standard delivered. Current trends discussed. 3. Motor vehicles trends and projections from U.S. industrial outlook 1983 presented and reviewed. 4. The basics of press feed automation reviewed. Specific information on Minster/ORII press robot system delivered. Misc. info on other suitable robots also delivered. 5. Delivered and reviewed the "Power Press Safety Manual" published by the U.S. National Safety Council. This is a very comprehensive source on design and tooling safety for power presses and is an industry standard.	5. Get original copy of "Power Press Safety Manual" for the company	The clutch manufacturing operation appears to be very orderly and efficient. This is to be expected as it is an assembly line operation. The power press manufacturing is more of a job shop operation. There is a large quantity of work-in-process inventory. This is characteris of a job shop. Better scheduling and shop floor control would improve the situation. The company could

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-D- Dong Sung Devel. Mfg. Company Auto & Truck Clutches and Mechanical Presses	5/19 Shin 5/31 Shin 6/13 Shin			6. Machine tool & metal forming trends and projections from U.S. Industrial Outlook 1983 presented and reviewed.		streamline the operation by employing CNC turning centers and CNC machining centers. Also, the company needs a spray painting booth.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-E- Sam-U Dies & Machine Mgf. Co. Molds for Injection Molding	5/23 Shin 6/2 Shin	1. Technology to mold two color computer keyboard keys. 2. Better methods to engrave dies to letters & figures. 3. General technology and management audit.		1. Information on co-injection and two-shot molding was delivered and discussed. Specific information on propietary Japanese process for making sloped and sculptured keys is not available. 2. Instructed on methods currently employed. Delivered specifications on three dimensional engravers, electrical discharge machining, and wire electrical discharge machining. 3. Many subjects presented: four steps to better tools & dies, computer aided engineering in design of plastics tooling, building prototype molds, runnerless molds & general management techniques.		The company has recently acquired several CNC machine tools. The company is building an addition to the shop. The additional space is desparately needed. The current plant has no plan to its layout - it just happened. The company should rearrange machines when the addition is completed. The company asked some questions which were very narrow in scope and requires knowledge of proprietary processes.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-K- Samyang Heavy Machinery Iron Castings, Metal Fabrication & Machine Shop	5/24 Min 6/27 Shin 6/10 Shin			6. Two very technical articles on chill roll microstructure were presented. 7. A general review of cast iron metalurgy and heat treatment was done. 8. No longer a serious problem. 9. The review in Item 7 covered ductile iron also. 10. Recommendations for machining chill rolls were made. Guidelines for selecting tool steels and carbides were presented. New silicon nitride chemical cutting tools for cast iron were presented. Instructions for inspecting tolerance capabilities of large lathes were given.		greatly advanced the companys capability to weld iron castings. Greatly contributed to the understanding of full mold casting, introduced new materials, introduced new cutting tools, and generally advanced the companys knowledge of cast irons and heat treating. A very good report was established betwen the company's president and the consultant. They expected to keep in contact for further assistance.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-H- Nae Way Industrial Company Pump & Blowers	5/16 Shin 5/26 Shin 6/3 Shin	1. Research data and info on methods to reduce the thermal expansion coefficient of cast iron blower rotor. 2. Shafts are shrink fitted into either end of blower rotors. Rotors crack and/or shafts come out on machining. 3. Need design methods for centrifugal pumps to handle pump and paper mill products.	4. Company wants a complete copy of pump handbook	1. Presented research materials and instructed on cast iron alloys and on heat treating to reduce thermal coefficient of expansion. 2. Explained the source of the problem. Presented materials on heat and expansion fits. Assisted company in doing calculations on fit allowances and temperatures of heat or shrink fit and holding forces. 3. Presented handbook materials and recent articles on pump design and new pump materials. Specific information on pulp and paper pumps was delivered and discussed.	4. GIT contacted, pump handbook is on its way. 5. Check on possible joint venture with roper pumps.	This is a small but very productive operation. The company is equipped with some modern tools and pump testing equipment. The management is young and eager to learn. The assistance rendered was directly applied to existing problems. The company was delighted with the research materials and the assistance.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-K- Samyang Heavy Machinery Iron Castings, Metal Fabrication & Machine Shop	5/24 Min 6/27 Shin 6/10 Shin	1. Information on welding iron castings. 2. Practical examples of stress relief of large structures. 3. Introduction & economic data on casting large parts 4. Information on full mold casting. 5. General update on alloyed castings - abrasive resistant iron 6 Information on variables involved in producing chill rolls. 7. Metallurgy of 55,000 psi cast iron. 8. Eliminate core defects in large ductile castings. 9. Annealling 60,000 psi ductile iron roll shells 10. Guidelines for machining chill rolls, introduction to new tool materials.	4a. What is water soluble & permeable ceramic pattern coating for full mold casting. Brand name if possible. 10a. Try to get a sample silicon nitride ceramic cutting insert.	1. Five separate articles on this subject were delivered. Procedures for performing welding of iron castings were developed. 2. Consultant related his own experiences and made suggestions for methods and equipment. 3. Comparative cost and design features of various casting processes were presented and discussed. Listings of molding materials and their attributes were delivered. 4. Handbook material and a recent article on full mold casting were presented. A discussion on full mold and ceramic shell molding was undertaken with the foundry manager. 5. Presented and discussed reseach materials on high sulfur wear resistant iron and compacted graphite iron. Both were new to the company and very applicable.	4a. Will contact ARCO Chemical Co. and try to get info. 10a Will contact GTE Walmet Division & request a sample quantum 5000 insert	This company has a huge facility and a corresondingly large capability. The managers are very bright and well informed. They were very pleased to receive the assistance and devoted considerable time to studying the research materials and confering with the consultant. The bulk of the material presented was new knowledge for the company as it came from very recent articles and papers. The assistance

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-N- Jeil Engnr & Industrial Company Geras xmisions	5/18 Shin 5/30 Shin 6/14 Shin	1. Examples of AGMA standards in design of gears. 2. Experience or comments about AGMA standards. 3. Ways to relate strength of materials to hardness. 4. Methods to calculate gearbox load limits based on gear box temperature. 5. Methods to calculate amount of lubrication required in a gearbox. 6. Methods to calculate expected noise levels in a transmission. 7. Information on Novikov gearing.	1a Company wants assistance in obtaining a copy of the new AGMA standard 218.	1&2 AGMA issued a new rating standard for involute gears in December 1982. Instructed the company in the changes and reviewed examples of typical designs. 3 Instructed company on mathematical models to determine stress distribution below the tooth surface, case hardness distribution and case depth are primary parameters that establish surface load capacity. 4&5 Temperature and lubrication are closely linked in the calculation and rating of a transmission. Instructed company in the critical temperature concept and the minimum film thickness concept. Both these calculations require the use of imperical data taken from a source such as AGMA.	1a Consultant wrote a letter in behalf of the company to AGMA and will continue to follow up until the company receives AGMA 218.	This company has a large design staff. The individual citing the problems was a design engineer, hence all the problems were related to design. It is unfortunate that the consultant was not able to bring a copy of the new AGMA 218 as the company and the consultant could have benefited from reviewing the new standard together. Many of the subjects undertaken were very abstract and complex.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-N- Jeil Engnr & Industrial Co. Gears xmissions	5/18 Shin 5/30 Shin 6/14 Shin			6. Instructed the company in design guidelines for quiet transmissions. Also instructed in methods to minimize noise in existing transmissions. 7. Presented the company with four USSR Research papers on Novikov gearing. Discussed the high points in the materials. Generally Novikov gearing is used in high speed, low load, low noise application.		Many relate only to high speed transmissions. They don't have relevance to the company's line of low speed reducers. However, the company seeks to produce high speed transmissions in the near future and in this case the information will be quite useful.

A-3333

TRAINING AND EXTENSION SERVICES TO THE KOREA CREDIT GUARANTEE FUND

Fifth Year
Annual Report
(August 1, 1982 to July 31, 1983)

by

Kenneth Maddox

Technology Applications Laboratory
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332, U.S.A.

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FORWARD AND ACKNOWLEDGEMENTS

This is the annual report for the fifth year of technical assistance provided by Georgia Institute of Technology to and in cooperation with the Korea Credit Guarantee Fund (KCGF). During this five-year period there have been many changes in the substance and emphasis of the program. However, one characteristic has been enduring and consistent: the goodwill, cooperation, and mutual respect evidenced between the KCGF and Georgia Tech.

We acknowledge with gratitude the contributions of the Korea Credit Guarantee Fund to this past year's activities in furthering technical efforts, dealing with logistical and contractual matters, and generally maintaining an excellent professional environment in which positive results could be achieved.

In particular:

- Chairman and President Kim, Sang-Chan has continued his interest and support for this program.

- Mr. Kim, Waan-Kee, Director, Extension Service Department has exemplified the excellent spirit of cooperation that has existed between our two institutions. His personal efforts have ensured the necessary support from KCGF to provide successful technical assistance to client companies.

- Mr. Lee, Hee-Il, Deputy Director of the Extension Service Department, provided encouragement and support and of the field engineers during their visit.

- Mr, Kim, Deok-Kon, Manager, Extension Service Department, assisted with the planning and communications so necessary to the project's success.

- Members of the Extension Service Department staff, including Mr. Shin, Jung-Sup; Mr. Seon, Yong-Hoon; and Mr. Min, Kyung-Sup, were instrumental in making appointments with companies, working with Georgia Tech field engineers, and providing the logistical support required for the field visits.

We are grateful to these individuals and to the KCGF for the opportunity to work with them to further the improvement of Korean industry.

INTRODUCTION

Beginning in 1978, the Georgia Institute of Technology has provided the Korea Credit Guarantee Fund (KCGF) assistance in KCGF's extension work with client companies. Georgia Tech's contribution has been to improve manufacturing productivity through the provision of technical assistance by field engineers directly to the client companies and indirectly by training KCGF Extension Department staff in the management and conduct of technical extension services.

The ultimate goal of this series of activities has been to produce within KCGF a technical extension staff capable of replacing Georgia Tech field engineers completely. The advantages for KCGF of developing staff capability are many: better communications with client companies, technical improvements that can enhance productivity, improved opportunities for follow-up and interaction, efficient use of manpower and financial resources. As more responsibility transfers to the KCGF staff, the need for outside assistance lessens.

The fifth year project summarized in the next section had initially two major objectives:

- Training of KCGF staff in Georgia, and training in Korea through participation in field visits and research for client companies.
- Technical assistance with manufacturing problems directed to selected KCGF client companies.

However, due to budgetary limitations the KCGF requested a reduction in the scope of the project, to eliminate the training originally scheduled for Georgia. As a consequence, this year's effort dealt only with direct technical assistance by Georgia Tech field engineers. Moreover, to accomodate the process of changing the work scope, field activities were delayed until calendar year 1983. As a result, there were neither field activities nor quarterly reports for the first half of the project year. Two quarterly reports have been prepared prior to this final report, covering the periods February through April and May through July. They describe three field visits that began in February, April and May.

In order to avoid redundancy with the two quarterly reports written during the project year, the summary in the next section presents only highlights of the year's activities. At the same time it is worthwhile to present in this final report an indication of the specific activities undertaken during field visits. Consequently, summary documentation taken from each of the three field trip reports has been appended in three sections following in chronological order. If even more detailed information is needed, the reader is referred to the quarterly reports where, in addition to the summaries, narratives describe company assistance by client.

PROJECT SUMMARY

The major activities of the project year, in summary, were:

- First field visit (February 19 - March 25, 1983). Mr. Larry Edens conducted this visit, assisting seven companies through 17 plant trips and associated research and problem solution. Twenty-one assistance actions were undertaken in Korea, and 13 follow-up activities were pursued after Mr. Edens' return to the United States.
- Second field visit (April 1 - May 5, 1983). Dr. James Bannerman worked with six companies, providing 32 assistance actions and four follow-up activities.
- Third field visit (May 14 - June 17, 1983). Mr. James Muller provided 37 separate actions of technical assistance to six companies during 18 plant trips. An additional eight follow-up actions were taken after Mr. Muller left Korea.
- Research, information, preparation, and reporting. These activities supported the field visits. They included Atlanta - and field-office based research activities to prepare for field visits, provision of information to Korea, preparation of field and quarterly reports and this final report, communications, logistics, and budget information required to support the project.

The project field visits continued the procedure begun last year of prioritizing companies' problems, so that the Georgia Tech and KCGF staffs could efficiently address client needs. The prioritization

also assured that all clients received adequate attention, since top priority problems for all companies were addressed first before turning attention to lower priority tasks. Beneficial results from the concentration on priority problems were apparent, and field engineers were generally able to go beyond priority areas to address additional problems as well.

The technical assistance provided during field visits dealt primarily with improvements in manufacturing techniques and technology. General issues such as plant layout, materials handling, and work flow were once more, as in past years, important to effective technical assistance. They were complemented by much more product-specific work which required intensive research and considerable specialization for effective results.

Technical assistance during the field visits typically followed a long-established pattern, described in previous annual reports as follows:

"a. Preliminary Meeting. KCGF scheduled an appointment for KCGF and GIT technical personnel. This meeting was usually held at the company factory where the manufacturing operation was observed. First, company management discussed the company's background, products, processes, and other pertinent material. An inspection of the manufacturing facilities followed, with a discussion of the company's technical problem and needs. Where appropriate, suggestions for production improvements were made immediately. A final session reviewed technical areas where assistance or information could be helpful.

b. Second and Subsequent Meetings. As soon as relevant information was available or assistance ideas were formulated, KCGF scheduled one or more subsequent visits to the company. KCGF and Georgia Tech then presented the information or technical assistance concepts to the company, utilizing detailed explanations, sketches, calculations, or whatever was needed to permit management to give consideration to the recommendations."

It has been suggested previously that Extension Service Department personnel of KCGF check back periodically with the companies that have been provided information and assistance in order to determine, first, what actions had resulted from the recommendations, and second, if there were additional problems or needs. These checks, a regular feature of Georgia Tech's Extension work in Georgia, would allow KCGF to ascertain whether or not additional plant visits will be needed by consultants. This suggestion is once again made for KCGF's consideration.

Companies assisted in this project year are:

A. Yu-Il Company, Ltd.

B. Kyung-Il Precision Machinery Company, Ltd.

C. Rolens Watch Ind. Company, Ltd.

D. Dong Sung Development Manufacturing Company, Ltd.

E. Sam U Dies and Machinery Manufacturing Company, Ltd.

F. Kyung-Won Ferrite Company, Ltd.

G. Sae Han Electric Wire, Ltd.

H. Nae Way Industrial Company, Ltd.

I. Dan Kwang Company, Ltd.

J. Sam Shin Iron Ind. Company, Ltd.

K. Sanyang Heavy Machinery Company, Ltd.

L. Shin Il Precision Company, Ltd.

M. Sam Jung Electric Ind. Company, Ltd.

N. Jeil Engineering and Industrial Company, Ltd.

O. Bukdoo Eumhyang Company, Ltd.

P. Enterprise Company, Ltd.

Q. Dong Bang Electronic Company, Ltd.

R. Seo Il Industrial Company, Ltd.

The results of the field visits were impressive numerically and qualitatively. Altogether 115 separate items of assistance were provided to the selected KCGF client companies during the project year. Company acceptance and implementation of recommendations appeared very high (but this observation should be checked periodically by KCGF staff, as noted previously). KCGF staff accompanied field engineers on visits and were thus exposed to informal exposure and on-the-job training in extension work.

Eighteen companies assisted, more than 50 individual technical visits and 115 individual instances of assistance demonstrate the success of this project year. The KCGF staff and Georgia Tech personnel who participated in this year's effort are deserving of commendation for a job well done.

As the project year drew to a close, the KCGF informed Georgia Tech that budgetary constraints require the elimination of field

visits, as they had previously caused the cessation of formal training for KCGF staff in Atlanta. Thus the type of management and technical assistance program conducted during the last five years will come to a close, or at least be temporarily halted. It seems appropriate, therefore, to look back over the past five years and draw some general conclusions that may be helpful if the KCGF management decides to reinitiate similar efforts in the future.

First, successful technical assistance can be provided using an outside institution. Five years of experience have shown that Korean companies will request such assistance and are willing to accept suggestions through KCGF from an outside service. The KCGF staff have proven adept at handling technical and logistical arrangements for foreign consultants, and generally the field visits have gone well. The basic premise of relying on U.S. expertise has been demonstrated to be feasible.

Second, the value of the assistance to participating companies appears to be high. As evidenced by this year's results, productivity-enhancing improvements can be made that beneficially affect competitive position, cost of products, and use of resources. In even so short a time as the five weeks of a field visit, a skilled engineer can provide cost-effective service to several companies.

Third, training of KCGF staff members can improve the effectiveness of the extension activities. KCGF staff have proven willing students and participants in extension activities. However, to ensure that skills can be properly developed and well used, careful planning and allocation of personnel are required. The provision of

adequate engineering services by KCGF staff presupposes sufficient, prior engineering background; some training in the past has been less than optimal due to the dissimilarities between staff background and the engineering subjects to be covered. Similar mismatches can be avoided through care in the selection of staff or through revision of course objectives and substance.

Fourth, recurrent problem areas among companies indicate the possibility of providing alternative forms of assistance. Needs for assistance in plant layout, for example, might more efficiently be dealt with in group interraction than through individual visits. Extension activities at Georgia Tech include group plant tours, seminars for plant engineers, publications of many types, information resources, and several other outreach methods. Extending assistance to many companies each year by subject area may provide KCGF with another mechanism to serve its client companies broadly, efficently, and with good results.

The need for technical assistance has been demonstrated time and again over the past five years, and the KCGF's foresight in providing for that need has been rewarded. As the KCGF extension program grows and changes in the years ahead, it is hoped that lessons from the previous work will contribute to even greater and broader success.

Appendix A

First Field Visit Summary

(February 19 - March 25, 1983)

SUMMARY REPORT
5TH YEAR KCGF/GIT PROJECT - 1ST VISIT
FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Dong Bang Electronics Co. Ltd. (Q) Fire Detector and Alarm Systems	2/21/83 Seon, Yong-Hoon 3/4/83 Shin, Jung-Sup 3/18/83 Shin, Jung-Sup	1. Improvements needed to the manual painting operation to increase efficiency and productivity.	2. Improvements need to be made in the assembly method for the fire alarm bell system. Currently, 30% of the alarm bell assembly units are rejected at the final inspection for failure to meet sound level standard. 3. A simpler method is needed for checking the air-tight seal on the small fire detector cases. Presently, a glass capillary is used which is mounted through a steel nut welded to the case. Leaks often occur around the welds.	1. • Provided a simplified layout for an improved painting operation which would include the use of an overhead conveyor and a continuous oven. • Provided copy of "Metals Handbook" section on painting of steel and cast iron. 2. • Presented to company a proposed 3-step method to improve precision and reliability in the asembly of the alarm bell units. • Designed a point assembly locating jig to improve precision when used with gage measurements of the point gap as recommended in above method. 3. • Provided copy of "Mechanical Design and Systems Handbook" section on adhesive bonding. • Discussed with company their idea for replacing the glass capillary system with a rubber plug through which a needle could be inserted to check for seal. This approach to problem was encouraged.	2. Follow-up needed on the use of the point assembly locator jig. 3. Follow-up needed on use of the rubber plug for checking fire detector seal.	The company management is very innovative and receptive to ideas for improving products and assembly methods. The development of the point assembly locator jig and the use of a gage in setting the point gap should reduce rejects at the final inspection of the fire alarm bell assemblies. The company has already ordered some sample silicone rubber plugs to be tested as replacement of the glass capillary system. If successful, the change in design will eliminate many quality problems. Major changes to the painting operation are not justified at this time. The firm makes over 200 products and the volume of individual products must be greater before an acceptable payback could be realized from automation.

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FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Kyung-Won Ferrite Co. (F) Ferrite Magnet Products	2/22/83 Seon, Yong-Hoon 3/7/83 Shin, Jung-Sup	1. Information requested on the design and manufacture of ferrite ring magnets. 2. Information on the design of magnetizing coils.	1. The company's mixing and sizing (screening) equipment is very antiquated. Drying equipment is inadequate--some drying was being accomplished by spreading material on top of the heat treatment oven. Entire facility is old, crowded, and poorly lighted. 2. The major quality problem is the deviations in the ring's magnetic field from the desired levels. This causes increased current consumption in the motors. Sample testing indicates that the company has been using the same magnetizing coil since last year for the 31 mm ring.	1. Provided copy of "Metals Handbook" section on magnetic, electrical, and other special purpose materials. • Provided 4 recent articles from technical journals on the manufacture of permanent magnets, which included information on alloy compositions, particle size control and lubrication. 2. The company confirmed that most of 31 mm rings since last year were magnetized on the same coil. The importance of developing an improved coil design was discussed with the company staff. No helpful information was found in the literature on this topic. Recommended that the firm try a coil with a slightly narrower yoke and less wire turns. The field levels produced now are stronger than required. Variations in field could be caused by uneven gap between ring magnet and magnetizing coil.	2. Follow-up with company by KCGF staff to encourage improvement of the magnetizing coil. Assistance could be obtained from a motor winding shop to develop a better coil by trial and error.	The company management is receptive of assistance, but their time is limited because of heavy involvement in the daily operation of the shop. Much of the equipment and the overall facilities are antiquated. The company management will probably continue to need outside assistance on technical matters in order to improve the quality of products.

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FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Saehan Electric Wire Co. Ltd. (C) Electric Wire and Cable Products	2/23/83 Seon, Yong-Hoon 3/8/83 Shin, Jung-Sup	1. Quality control of cable insulation. . Low elongation of PE insulation on 22 KV cable. . Separation of nylon cover on PE insulation of military transmission wire. . Temperature control of PE and PVC jacket materials. . Need improved methods for printing on wire/cable insulation. . Need in-line instrumentation to measure wire and insulation diameter. 2. Information needed on copper wire drawing and annealing, in particular on the "vacuum" annealing process. 3. Copper wire plating problems because of excessive oxidation on the surface of the molten tin bath. 4. Information needed on the manufacture of flat cable. 5. Information needed on the manufacture of large diameter telephone cable.	1. Excessive vibration and movement was noticed in the extruding heads which resulted in a wave effect on the large diameter insulation. 2. The company has purchased a new wire drawing system which has solved some problems in drawing and annealing. 3. The surface of the tin bath was covered with oxidized material (dross). Part of the problem in plating could be solved by regular maintenance and cleaning of the bath. 4. The company has an extremely broad product line and seems interested in developing new products to cover every segment of the wire and cable market. This may not be practical considering the limitations of their present plant. 5. The plant tour revealed a high incidence of safety hazards, primarily the lack of proper guarding around heavy equipment and exposed or worn electrical wiring and connectors.	1. Provided copies of 20 recent articles from technical journals on the insulation of wire and cable products. . Provided a package of information by Union Carbide Corp. on wire and cable insulation, including product data sheets and technical papers. . Discussed with the company engineers the operation of the ink-jet printer which is being developed by Western Electric. The system can be controlled by a small computer. 2. Provided copies of 10 recent articles from technical journals on copper wire drawing and annealing. These included 2 articles on the "vacuum" process. 3. Discussed proper care of the tin bath with the company staff. U.S. tech. representative did not recommend the use of flux. . Recommended the use of a protective gas tinning operation which would be directly in-line with the wire drawing process. Provided technical paper by Stoiber from Wire Industry, May 1981, on this system. Tin loss is reduced to almost zero. 4. Provided 3 technical papers on the design and production of flat cable. 5. Provided copies of product catalogs and data sheets from 6 U.S. companies on wire and telephone cables.	1. The company is interested in additional information on the ink-jet cable and wire printer. The G.I.T. consultant will contact the Western Electric Co. to determine the status of this development. 2. The company has extreme interest in entering the flat cable market. It was requested that G.I.T. investigate any possibilities for a joint venture between Saehan and a U.S. company with flat cable technology.	The company has several technical staff members and they are very receptive of technical information., Their efforts at times appears to be more oriented towards new product development than towards product improvement. Based on limited contact, the G.I.T. consultant recommends that the company strive to improve its quality of products and somewhat limit its product lines over the short term. The company has plans for a large facility in the southern part of the country.

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FIELD ENGINEER - LARRY R. EDENS

COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Sammi Enterprise Co. Ltd. (P) Loud-speakers and Speaker Systems	2/24/83 Seon, Yong-Hoon 3/11/83 Shin, Jung-Sup 3/22/83 Shin, Jung-Sup	1. Assistance needed in improving use of integrated circuits in megaphone products. 2. Information needed on methods for producing paper speaker cones, including paper composition data, types of cone forming equipment, and improved adhesives. 3. Information needed on the design of magnetic field and voice coil systems. 4. Information on automatic speaker testing equipment.	1. The battery system of the SAM 34R megaphone will operate at acceptable amplification and clarity for only 3-5 hours instead of the design specification of 6+ hours. 2. The company is interested in using a cone forming system referred to as the "Heat Shock Method." The method is reportedly used in Japan. . Need product data on adhesives which will not deteriorate at higher temperatures. 3. Company products with higher performance levels incur problems from overheating voice coils. Need information on design methods to reduce voice coil temperatures.	1. Provided information from Mr. Harris Johnson (G.I.T.) on the design of integrated circuits for megaphones. Provided specification sheets for National Semiconductor Company I.C.s (LM 386L, LM 389, and LM 2002A) which may be suitable for their application. Johnson gave several suggestions for redesign of the system. 2. Provided copies of 5 recent technical articles on improved designs for speakers. Discussed the present trend towards plastic and graphite cone materials with the company management. . Provided a copy of a special Application Development Report by Loctite Corporation entitled "Audio Speaker Seminar" which includes an in-depth evaluation of adhesives used in speaker construction. 3. Loaned the company a technical handbook--<u>High Performance Loudspeakers</u>, Martin Colloms, 2nd ed., John Wiley & Sons, 1980--which provides detailed information on voice coil design. The firm made a copy of the needed material. 4. Provided a technical article from the <u>Journal of Audio Engineering</u> on "Production Testing of Loudspeakers Using Digital Techniques." Conducted an in-depth discussion of this article with the technical manager.	2. The company is interested in additional information on new materials and methods for speaker construction. . Need information on the availability of technology for graphite cones. . Need information about the "Heat Shock Method" of cone forming. 4. Need additional data on automatic loudspeaker performance measurements and computer-based analysis of speaker units. Need catalogs of available equipment. 5. The G.I.T. consultant will provide the company with information about membership in the Audio-Engineering Society. They need to receive the <u>Journal</u>.	On the third visit to this company it was apparent that the managing director and technical manager had carefully studied and reviewed all of the materials provided on earlier visits. They were very appreciative of the assistance provided. The firm has well developed plans to up-grade the quality of its speaker products. They have a keen interest in new technical developments and will utilize much of the information.

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Shin Il Precision Co. Ltd. (L) Small Electric Motors, Timers, and Switching Devices	2/25/83 Seon, Yong-Hoon 3/14/83 Shin, Jung-Sup	1. Company needs design information on shaded-pole induction motors, including materials of construction for coils, core, and rotor. . Data are needed on the treatment method used to obtain black, oxidation-resistant, surface on cores. . A comparison of DuPont "Delrin 500 CL" and Japanese "Duracon Mod" acetal resins in needed. 2. Information on effects of manual versus automatic coil winding on the magnetic field that is generated.	1. Comparison data on acetal resins are no longer needed. 3. The company has now undertaken the production of a small synchronous (stepping) motor with 12 and 24 poles. Design information is needed for this type motor.	1. Information on shaded-pole motor design was provided from the following handbooks: (a) Machine Design--The Electric Motor Book (b) Electric Motor Handbook (c) Fractional Horsepower Electric Motors . Provided copies of 5 recent technical articles on the design of shaded-pole motors. . Discussed with the company staff the advantages of using a continuous copper ring (stamped) instead of welded wire for the shading coil. . Provided information on the carburizing of steel for surface hardening and protection against oxidation. 2. Provided information on manual versus automatic coil winding from Coil Winding, W. Querfurth, 3rd ed., 1968.	3. The company needs information on design and manufacturing methods for small synchronous motors. 4. In general, the company needs to develop a library of technical information on small electric motors. The G.I.T. consultant will obtain publishers' lists of motor related reference books for the company.	This company is essentially copying proven or rather standard designs for small electric motors and manufacturing them for export. However, the staff has little understanding of the motor theory or the effect of changes in the design parameters. They are very eager to increase their knowledge of these products. The assistance provided was greatly appreciated and gaive the technical stafff their first hard technical material on small motors. The company appears exceptionally well managed and efficiently operated.

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COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUS OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Sam Jung Electic Ind. Co. Ltd. (M) Automobile Radios and Tape Players	2/28/83 Shin, Jung-Sup 3/15/83 Shin, Jung-Sup 3/22/83 Shin, Jung-Sup	1. Noise problems caused by auto radio testing. 2. Quality control improvement needed to reduce the 6% reject rate at final inspection. 3. The company wants ideas for improving the product development process by changes in the organizational structure or inter-departmental relationships.	1. By discussing the audio testing process with the company staff and a noise consultant in the U.S., the G.I.T. engineer concluded that the problem (although a nuisance) was unlikely to be a health hazard. The actual periods of high level noise are very short. This testing procedure is commonly used in the U.S. and meets OSHA requirements. 2. The quality control tests, made in-process on each unit and the final inspection sample testing, are highly technical and require sophisticated test equipment and procedures. Copies of the final inspection forms were obtained. 3. Separate departments such as engineering, marketing, and production seem to operate rather independently. The main administrative office is in Seoul, but the Production Plant is at Yongin.	1. The plant noise problem due to product testing is not considered a high priority item. No recommendations were made to expend capital to reduce the noise level. 2. All in-plant time was used to investigate the complicated process of quality control testing. Due to the large number of tests required, it would be advantageous to set up a computer controlled system to perform a sequence of testing and analyze the results. The G.I.T. consultant has neither the electronic experience nor the resource materials on hand to offer assistance during this visit on the specific equipment needed. . Information on general quality control practices was provided as follows: (a) Quality Control Handbook, 3rd ed., 1974. Section 38 - Electronic Components and Section 41 - Assembly Control. (b) Industrial Engineering Handbook, 3rd ed., 1971. Section 8, Chapter 5 - Quality Control.	2. The G.I.T. consultant will discuss the testing requirements (as shown on sample inspection forms) with an electronics engineer in the U.S. Recomendations will be made to the company on computerized testing systems. 3. Problems in product development organizational methods will be addressed by Dr. Bannerman (G.I.T.) in April/May.	The results from field visits to this company were limited because of two reasons: (1) The company management was not well prepared for the initial visit. This may have been due to lack of inter-departmental coordination. (2) The G.I.T. consultant has very limited knowledge and experience in specific quality control testing in the electronic field and suitable reference resources were not available at KCGF. However, the plant (Yongin) quality control manager was highly interested in any assistance which could help automate the Q.C. testing work required. The company wants to expand production by 50% to about 30/000 units/month.

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COMPANY NAME PRODUCT OR SERVICE	VISIT DATES KCGF STAFF	PREVIOUSLY OBSERVED PROBLEMS OR QUESTIONS	OBSERVED PROBLEMS OR QUESTIONS ASKED DURING CURRENT PERIOD	ACTION DURING CURRENT PERIOD	FUTURE COMPANY REQUIREMENTS	OBSERVED RESULTS AND COMPANY REACTIONS
Buk Doo Eumhyang Co. Ltd. (O) Speakers and Speaker System Assembly	3/2/83 Seon, Yong-Hoon 3/16/83 Seon, Yong-Hoon	1. Information needed on paper cone speaker technology. 2. Information needed on adhesive technology application to speaker production (Other previously observed problems related to inventory control computer will be addressed by Dr. Bannerman in April/May.)	1. The company presently purchases all speaker cones from other companies. But, they want to eventually design and produce cones. Interested in licensing a process. . The company would like information on Holly Speakers (U.S.A.) . Management is interested in information on the Audio-Engineering Society. 2. The company asked for recommendations for an adbesive to bond a rubber gasket to a mylar film cone. 3. Requested information on an integrated quality control system for production of electronic products.	1. Provided copies of 5 recent articles on improved designs for speakers. Discussed the trend towards the use of plastic and graphite cone materials. . Discussed the problems of acquiring technical information in the highly secretive cone technology field. The licensing of a process was encouraged as a means of entering the top-quality market. 2. Provided a copy of a special application development report by Loctite Corporation entitled "Audio Speaker Seminar" which includes an in-depth evaluation of adhesives used in speaker construction. . Recommended ethyl-cyanoacrylate (Loctite 420, 495, or 414) for bonding the rubber gasket to a mylar cone. 3. Provided a technical article from the Journal of Audio-Engineering on "Production Testing of Loud-Speakers Using Digital Techniques." Discussed use of computer systems in quality control.	1. Upon return to U.S., the G.I.T. consultant will send to the company (via KCGF) information on: (1) Holly Speakers (2) The Audio-Engineering Society	The management was particularly appreciative of assistance in adhesive applications. They seem,to have problems getting technical assistance or information from U.S. companies from which they purchase products. This company is very progressive and during the visit period moved manufacturing operations to a new plant about 20 miles north of Seoul. The plant site has space allocated for the location of sub-contractors or major part suppliers.

Appendix B

Second Field Visit Summary

(April 1 - May 5, 1983)

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E.

COMPANY NAME Product or Service	VISIT DATES KCGF Staff	Previously Observed Problems or Questions	Problems Observed & Questions Current Visit	Actions During Current Visit	Future Company Requirements	Observed Results & Company Reaction
San Jung Electric Ind. Co. Ltd. Automobile Radios and Stereo Equipment	April 12, 1983 April 19, 1983 Mr. Shin Jung-Sup	1. Noise problem caused by Q.C. testing at high volume. 2. Need information on Q.C. procedures for auto radios 3. Need information on product development organizational structure.	4. Problems 1 & 2 were assigned to the previous GIT consultant. 5. The client stated that the company management had changed and that they did not perceive a problem in the area of organizational structure as previously reported as problem 3. However, since the consultant had performed the research they would like a briefing on a suggested organizational structure.	1. The consultant prepared and presented a paper on the matrix organizational structure with particular emphasis on how it could be applied to the product development activity at San Jung Electric Co. Ltd. 2. Provided copies of the following documents relating to matrix organization structure: *Argyris, C. "Todays Problems with Tomorrow's Organizations"; Journal of Management Studies, Feb. 1967 *Davis, S.M. "Problems of Matrix Organizations"; Harvard Business Review, May-June 1978 *Galbraith, J.R. "Matix Organizations Design"; Business Horizons, Feb. 1971 *Gibson, J.L. Organizations, Business Publications, Inc. Plano, Texas 1982 (Chapt. 11, "The Anatomy of Organizations") *Knight, K. "Matrix Organizations: A Review"; The Journal of Management Studies, May 1976 *Sisk, H.L. Management & Organizations, South-Western Publishing Co. Cincinnati, Ohio 1981 (Chapt. 9, "The Structural Design of Organizations")	The company representative stated that they had no problems or questions which required consultant assistance. No future actions are anticipated.	The company representatives were receptive and seemed to be interested in the new ma agement concept proposed by the consultant. Since, ho ever, they do not have a p lem there is some doubt th the suggestions will be im plemented. They promised deliver the material to th superiors for considerati

SUMMARY REPORT

KCGF/GIT Project — April 1, 1983 thru May 5, 1983 — James W. Bannerman P.E.

COMPANY NAME / Product or Service	DATES VISITED / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed on Current Visit	Actions Taken During Current Period	Future Actions Required	Observed Results & Reactions
Bukdoo Industry Co. Car Radio Speakers	April 6, 1983 April 18, 1983 April 25, 1983 April 29, 1983 Mr. Shin Jung-Sup	1. Inadequate space for raw materials storage. 2. Need information about computerization of Inventory and Production Management functions. 3. Paper cone technology (assigned to another consultant)	4. Production line not properly balanced - results in non-productive labor. Company wants instruction on methods of production line balancing. 5. Several work stations poorly laid out and in violation of the principles of motion economy. Company wants instruction in methods of work station design.	1. Consultant wrote and presented a paper concerning the A-B-C method of inventory control as it would apply to the Bukdoo Co. Made recommendations for implementing a manual inventory management system which could be adapted to a micro-computer at a future date. Assisted the company in implementing the recommended system. 2. Consultant wrote and presented a paper summarizing the 22 principles of motion economy. Also designed and presented a proposed work station layout for one of the assembly line operations. Using these documents instructed the client in the technology of methods and work station engineering. 3. Demonstrated the methods of balancing a production line by actually balancing one of the current assembly lines. Reduced the number of required workers from 30 to 24 with no decrease in production. Wrote a memo describing significant points in the line balance effort and recommending client follow-up.	All the identified problems and questions were resolved. The company has indicated an intention to implement all three recommendations. There are other areas for productivity improvement at Bukdoo but they should be delayed until the current efforts are assimilated. As the current recommendations are implemented some technical assistance may be required.	The company Production Engineer and President were most appreciative of the research conducted by the consultant. They indicated that they planned to implement each of the suggestions. Evidence of their intentions was observed during the last visit is: 1. The work station design submitted by the consultant had been built and was being used with a noticeable increase in efficiency. 2. The "help wanted" sign at the company gate was removed in anticipation of increased productivity with existing employees thru methods engineering.

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E.

Company Visited / Product or Service	VISIT DATES / KCGF Staff	Previously Observed Problems or Questions	Observed Problems or Questions Current Visit	Actions During Current Period	Future Company Requirements	Observed Results and Company Reactions
Rolens Clock Co. (Company 3) Watches and Wall Clocks (both electric and spring operated)	April 8, 1983 April 14, 1983 Mr. Shin Jum-Sup	1. Need information on how to reduce the cost of the stator in the electric clock motor. Current material is 25% Si and 75% Fe and cost about 300 won (45¢) each. Almost 1/2 the price of the clock motor is in the stator.	2. Production line is inefficient due to lack of methods engineering and work place design. 3. Lack of automation. Almost all operations are performed by hand or with hand powered tools.	1. Provided a sample of material used in clock motors by Westclock Co. in U.S. Material is C1005 cold rolled steel with Rockwell "B" less than 55. Cost is about 1/10 of the price of the current material. 2. Provided names and addresses of steel manufactucer, metalurgist and ordering information. 3. Wrote a letter to Worthington Steel asking for a sample large enough for Rolens to run tests to be shipped directly to Rolens. 4. Made several suggestions pertaining to methods engineering and work place design for the company's production facility.	The GIT consultant provided his U.S. address and offered assistance in obtaining sample stator material for testing or in placing an order.	Client was extremely pleased with the prospect of obtaining a less expensive material for his clock motor stators. They will run tests when the sample arrives and if the material proves acceptable will probably change to the new material. Client was very appreciative of the consulting suggestions concerning productivity improvement but will probably not implement them at this time due to worker resistance.

SUMMARY REPORT

KCGF/GIT Project | April 1, 1983 thru May 5, 1983 | James W. Bannerman P.E

Company and Type of Service	Visit Dates / GIT Staff	Previously Observed Problems & Questions	Problems & Questions Observed Current Visit	Actions During Current Visit	Future Actions & Requirements	Observed Results and Company Reaction
Sa [illegible] rp Metal office furniture	April 11, 1983 April 29, 1983 Mr. Seow Mr. Shao	1. Problem with spot welding: a) The company wants to weld at longer reaches. Need information on welding equipment or modifications to existing equipment which will allow it. b) Current welding procedures produce dimples and surface blemishes. Need a welding schedule which will eliminate the defect. 2. Need information on automatic painting systems. 3. Need assistance in efficient plant layout and materials handling.	4. There is inadequate space to store finished inventory prior to shipment. Overflow is currently stored in aisles and in production area.	1. Provided information and equipment brochures describing modern resistance welding equipment - specifically equipment with long reach capability. 2. Provided a list of publications and ordering information for materials produced by the Resistance Welder Manufacturers Association. 3. Provided copies of the portion of the 1982 Thomas Register pertaining to resistance welding equipment. 4. Described the electrostatic spray painting process and provided brochures and equipment descriptions for the Ransburg Electrostatic Spray Painting System. 5. Provided a copy and discussed Chapter 6 "Conventional Techniques for Analyzing Material Flow" from Plant Layout and Materials Handling by James Apple. 6. Provided a copy of the section of the Metals Handbook pertaining to Resistance Welding. Went over the material page by page and emphasized the reason and methods of prevention of spot weld dimples. Emphasized the absolute necessity for a systematic investigation of various combinations of squeeze pressure, electrode characteristics and welding current to identify the best combination. Outlined a test procedure and made specific recommendations for the establishment of a welding schedule.	None.	The company representative was quite receptive and very appreciative of the research conducted and documentation provided by the consultant. It appeared, however, that the company will be somewhat reluctant to implement the suggestions. The electrostatic painting system may be too expensive; they are not sure (after consideration) that they need to weld at longer reaches; and they feel that a systematic investigation of the dimpling problem may be beyond their technical capability. They probably will make some effort to improve materials flow and storage layout using the procedures described by the consultant.

SUMMARY REPORT

KCGF/GIT Project — April 1, 1983 thru May 5, 1983 — James W. Bannerman P.E.

Company Visited / Product or Service	Visit Dates / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed Current Visit	Actions During Current Visit	Future Actions & Requirements	Observed Results & Company Reactions
Ding Kwang Co. Ltd. Cloth & Plastic Luggage	April 7, 1983 April 15, 1983 April 21, 1983 Mr. Shin Jung-Sup	1. Need information about equipment to install zipper stops. 2. Need information about technology of sewing long seams so that ends come out even. 3. Need information about modern sewing machines, accessories and materials 4. Need assistance in efficient sewing layout.	5. Need a large shear to cut up to 50 ply of P.V.C. up 150 cm (59") wide. 6. Need ability to establish "standard time" for each product so that the company can do production scheduling and forecasting.	1. Provided information and brochures from several U.S. companies who manufacture and/or distribute zipper bottom stop machines 2. Provided operating instructions, cost information, and ordering instructions for both new and used zipper bottom stop machines 3. Provided a copy of the 1982 edition of the SANBRAND catalog #231 - A complete line of cutting, sewing, finishing, and warehousing equipment, parts, and accessories 4. Provided information, catalogues, and brochures from a number of U.S. and international distributors of modern sewing machines and accessories 5. Analyzed the company's sewing machine requirements (in light of problems 1 & 2) and made specific recommendations for the acquisition of new equipment 6. Provided instruction to company personnel on methods of analyzing (Assembly chart, flow process chart, flow diagram) and implementing efficient plant layout and materials handling systems 7. Provided instruction on methods of establishing "standard times" and using that information to implement production control and scheduling 8. Provided the following documentation to support the information cited in 5 & 6 above: a. Apple, J.M. "Plant Layout and Materials Handling", John Wiley & Sons, New York 1977. Chapter 5 "Conventional Techniques for Analyzing Material Flow", and Chapter 11 "Space Determination" b. [illegible]	1. Consultant will, upon return to U.S., research and forward to the client through KCGF, information on large material shears 2. Consultant will upon return to U.S., research the availability of a pre-needle welt cutting attachment which the client claims to have seen on a machine in Taiwan	1. The client was extremely pleased with the documentation concerning new sewing machine equipment and accessories. He indicated that he planned to follow the consultant's recommendations for machine replacement 2. The client was very receptive and appreciative of the instruction provided concerning plant layout, setting time standards, and establishing production control and scheduling. Although some of the techniques may be beyond the technical competence of the plant personnel, they are now aware of the need for these techniques. The client indicated that he may hire a private consultant to implement the system recommended by the consultant

SUMMARY REPORT

KCGF/GIT Project — April 1, 1983 thru May 5, 1983 — James W. Bannerman P.E.

Company Name / Product or Service	Visit Dates / KCGF Staff	Previously Observed Problems & Questions	Problems & Questions Observed on Current Visit	Actions During Current Visit	Future Actions & Company Requirements	Observed Results and Company Reactions
Sae Shin Iron Ind. Co. Ltd. Forged Steel Valves & Fittings	April 4, 1983 April 26, 1983 April 29, 1983 Mr. Shin Jung-Sup	1. Want to purchase books on high pressure valve design and manufacture. Need a listing of current titles 2. Want to manufacture ASME "N" stamped valves. Need information on how to obtain ASME nuclear certification 3. Want to upgrade their machining operations by the acquisition of numerical control (NC) machines. Want information about currently available NC machines 4. Want current information on forging technology, need articles and titles of books on the subject	5. Quality Control supervisor reports that they are using an excessive amount of company resources to comply with MIL STD 105D Q.C. specifications. Need consultant to review their Q.C. procedures and make recommendations for reducing Q.C. effort but maintaining same Q.C. level 6. Company Q.C. department has a Rockwell hardness tester, but no calibration standards Need a certified calibration standard	1. Provided a Xerox copy of the title page, table of contents, and preface of six books on valve technology. A) Handbook of Values (P. A. Schweiter, 1972) B) Lyons Encyclopedia of Values (J. L. Lyons, 1975) C) Valve Design (G. H. Pearson, 1972) D) ISA Handbook of Control Values (J. W. Hutchinson, 1976) E) Lyons Valve Designers Handbook (J. L. Lyons, 1982) F) Valve Selection Handbook (R. W. Zuppe, 1981) 2. Provided copies of articles from two recent technical publications 3. Provided copies of the appropriate pages (relative to valve technology) from both the 1980 and 1981 editions of the Applied Science and Technology Index 4. Provided an application form and numerous documents describing the procedure for obtaining an ASME "N" stamp certification 5. Provided a copy of the Q.C. portion of Section III of the ASME Boiler and Pressure Vessel Code 6. Provided the name, address, and phone number of a contact within ASME for further information about "N" stamp certification 7. Provided the name and contact information of a U.S. company that will assist (for a fee) in obtaining "N" stamp certification 8. Provided a list of companies authorized as independent witnesses for Nuclear Q.C. inspections 9. Recommended that because of the cost and procedural difficulties involved Sae Shin Iron Ind. should consider subcontracting to another company who already has ASME certification rather than attempting to obtain their own certification	1. The consultant will obtain membership information for the American Society for Quality Control (ASQC) and forward to the client through KGGF 2. The company will investigate the possibility of subcontracting to a firm which already has the ASME "N" stamp certification	1. The company representative was very appreciative of documentation provided and was enthusiastic about many of the consultant's recommendations; specifically those concerning the ASME "N" stamp certification and the Quality Control procedures 2. The company's production facility is already quite modern by Korean standards, and they are interested in acquiring NC machinery; however the cost of acquisition may be prohibitive at this time. The company representative was anxious, however, to review the documentation and analysis that the consultant provided

Appendix C

Third Field Visit Summary

(May 14 - June 17, 1983)

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-B- Kung IL Precision Macinery Company Machine Shop Auto & Truck Axel Spindles	5/17 Shin 5/27 Shin 6/29 Shin	1. The company is turning forged steel and getting continuous chips. They need to know how to eliminate or to contend with these chips 2. Need suggestions to reduce machining time. 3. Quicking wearing out drilling jigs and hence parts are out of tolerance 4. Specification to sharpen sandvik BTA drills. 5. Holding tolerance on a 96mmm dia. +0.05 -0.00 x 31 mm length. 6. Is it better practice to use cutting fluids when machining with TIC tools (C + 5 to C-7)? 7. Need a method other than optical comparison to check surface finishes 8. Need better methods or equipment to cut		1. Delivered several current articles on chip breaking and chip control, instructed in proper practice and rules-of-thumb. 2. Many subjects covered and research materials delivered on choosing TIC inserts, high speed drilling, cutting speeds feeds, and modern cutting tools. 3. Common problem in Rok- improper sharpening of drill bits. Explained importance of proper drill bit geometry and provided specs on drill bit grinder. 4. Consultant provided Sandvik BTA catalog. Sandvik does not recommend resharpening, drill tips are disposable. 5. Reject rate is too low to be concerned. 6. Consultant provided articles pro & con. However, after seeing	3. Get prices on drill grinding machine (optima) 2. Contact at Valeron Corp. ROK office	This company has a very simple operation in that they basically do only turnings. They need to consider purchasing one or more CNC turning centers. With turning centers they could combine many operations on one machine. Productivity would be greatly increased and they could use modern cutting tools and cutting fluids. The company was very receptive and plans to buy a drill sharpener and try the consultants recommendations.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-B- Kung IL Precision Machinery Company Machine Shop Auto & Truck Axel Spindles	5/17 Shin 5/17 Shin 6/9 Shin Shin	Threads on axel spindles		The operation the consultant Recommends cutting dry. 7. Provided several alternatives and some specifications thereon. Mitutoyo is offering a device called Surftest III. 8. Provided specs on several types of high speed thread cutting machines		

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-D- Dong Sung Devel. Mgf. Company Auto & Truck Clutches and Mechanical Presses	5/19 Shin 5/31 Shin 6/13 Shin	1. Info on clutch facing materials 2. U.S. Regulations and trend toward asbestos use in clutches & brakes 3. Information on U.S. clutch market 4. Information on robot use with stamping presses 5. Safety standards that apply to U.S. presses 6. Marketing information on U.S. stamping presses		1. Many excellent materials delivered and reviewed on asbestos and new materials that will relace asbestos. Specific specs on "Kevlar". 2. Several good research papers reviewed. OSHA standard delivered. Current trends discussed. 3. Motor vehicles trends and projections from U.S. industrial outlook 1983 presented and reviewed. 4. The basics of press feed automation reviewed. Specific information on Minster/ORII press robot system delivered. Misc. info on other suitable robots also delivered. 5. Delivered and reviewed the "Power Press Safety Manual" published by the U.S. National Safety Council. This is a very comprehensive source on design and tooling safety for power presses and is an industry standard.	5. Get original copy of "Power Press Safety Manual" for the company	The clutch manufacturing operation appears to be very orderly and efficient. This is to be expected as it is an assembly line operation. The power press manufacturing is more of a job shop operation. There is a large quantity of work-in-process inventory. This is characteris of a job shop. Better scheduling and shop floor control would improve the situation. The company could

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

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-D- Dong Sung Devel. Mfg. Company Auto & Truck Clutches and Mechanical Presses	5/19 Shin 5/31 Shin 6/13 Shin			6. Machine tool & metal forming trends and projections from U.S. Industrial Outlook 1983 presented and reviewed.		streamline the operation by employing CNC turning centers and CNC machining centers. Also, the company needs a spray painting booth.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-E- Sam-U Dies & Machine Mgf. Co. Molds for Injection Molding	5/23 Shin 6/2 Shin	1. Technology to mold two color computer keyboard keys. 2. Better methods to engrave dies to letters & figures. 3. General technology and management audit.		1. Information on co-injection and two-shot molding was delivered and discussed. Specific information on propietary Japanese process for making sloped and sculptured keys is not available. 2. Instructed on methods currently employed. Delivered specifications on three dimensional engravers, electrical discharge machining, and wire electrical discharge machining. 3. Many subjects presented: four steps to better tools & dies, computer aided engineering in design of plastics tooling, building prototype molds, runnerless molds & general management techniques.		The company has recently acquired several CNC machine tools. The company is building an addition to the shop. The additional space is desparately needed. The current plant has no plan to its layout - it just happened. The company should rearrange machines when the addition is completed. The company asked some questions which were very narrow in scope and requires knowledge of proprietary processes.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-H- Nae Way Industrial Company Pump & Blowers	5/16 Shin 5/26 Shin 6/3 Shin	1. Research data and info on methods to reduce the thermal expansion coefficient of cast iron blower rotor. 2. Shafts are shrink fitted into either end of blower rotors. Rotors crack and/or shafts come out on machining. 3. Need design methods for centrifugal pumps to handle pump and paper mill products.	4. Company wants a complete copy of pump handbook	1. Presented research materials and instructed on cast iron alloys and on heat treating to reduce thermal coefficient of expansion. 2. Explained the source of the problem. Presented materials on heat and expansion fits. Assisted company in doing calculations on fit allowances and temperatures of heat or shrink fit and holding forces. 3. Presented handbook materials and recent articles on pump design and new pump materials. Specific information on pulp and paper pumps was delivered and discussed.	4. GIT contacted, pump handbook is on its way. 5. Check on possible joint venture with roper pumps.	This is a small but very productive operation. The company is equipped with some modern tools and pump testing equipment. The management is young and eager to learn. The assistance rendered was directly applied to existing problems. The company was delighted with the research materials and the assistance.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-K- Samyang Heavy Machinery Iron Castings, Metal Fabrication & Machine Shop	5/24 Min 6/27 Shin 6/10 Shin	1. Information on welding iron castings. 2. Practical examples of stress relief of large structures. 3. Introduction & economic data on casting large parts 4. Information on full mold casting. 5. General update on alloyed castings - abrasive resistant iron 6 Information on variables involved in producing chill rolls. 7. Metallurgy of 55,000 psi cast iron. 8. Eliminate core defects in large ductile castings. 9. Annealling 60,000 psi ductile iron roll shells 10. Guidelines for machining chill rolls, introduction to new tool materials.	4a. What is water soluble & permeable ceramic pattern coating for full mold casting. Brand name if possible. 10a. Try to get a sample silicon nitride ceramic cutting insert.	1. Five separate articles on this subject were delivered. Procedures for performing welding of iron castings were developed. 2. Consultant related his own experiences and made suggestions for methods and equipment. 3. Comparative cost and design features of various casting processes were presented and discussed. Listings of molding materials and their attributes were delivered. 4. Handbook material and a recent article on full mold casting were presented. A discussion on full mold and ceramic shell molding was undertaken with the foundry manager. 5. Presented and discussed reseach materials on high sulfur wear resistant iron and compacted graphite iron. Both were new to the company and very applicable.	4a. Will contact ARCO Chemical Co. and try to get info. 10a Will contact GTE Walmet Division & request a sample quantum 5000 insert	This company has a huge facility and a corresondingly large capability. The managers are very bright and well informed. They were very pleased to receive the assistance and devoted considerable time to studying the research materials and confering with the consultant. The bulk of the material presented was new knowledge for the company as it came from very recent articles and papers. The assistance

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
3rd Field Engineer Visit, James Muller

Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-K- Samyang Heavy Machinery Iron Castings, Metal Fabrication & Machine Shop	5/24 Min 6/27 Shin 6/10 Shin			6. Two very technical articles on chill roll microstructure were presented. 7. A general review of cast iron metalurgy and heat treatment was done. 8. No longer a serious problem. 9. The review in Item 7 covered ductile iron also. 10. Recommendations for machining chill rolls were made. Guidelines for selecting tool steels and carbides were presented. New silicon nitride chemical cutting tools for cast iron were presented. Instructions for inspecting tolerance capabilities of large lathes were given.		greatly advanced the companys capability to weld iron castings. Greatly contributed to the understanding of full mold casting, introduced new materials, introduced new cutting tools, and generally advanced the companys knowledge of cast irons and heat treating. A very good report was established betwen the company's president and the consultant. They expected to keep in contact for further assistance.

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-N- Jeil Engnr & Industrial Company Geras xmisions	5/18 Shin 5/30 Shin 6/14 Shin	1. Examples of AGMA standards in design of gears. 2. Experience or comments about AGMA standards. 3. Ways to relate strength of materials to hardness. 4. Methods to calculate gearbox load limits based on gear box temperature. 5. Methods to calculate amount of lubrication required in a gearbox. 6. Methods to calculate expected noise levels in a transmission. 7. Information on Novikov gearing.	1a Company wants assistance in obtaining a copy of the new AGMA standard 218.	1&2 AGMA issued a new rating standard for involute gears in December 1982. Instructed the company in the changes and reviewed examples of typical designs. 3 Instructed company on mathematical models to determine stress distribution below the tooth surface, case hardness distribution and case depth are primary parameters that establish surface load capacity. 4&5 Temperature and lubrication are closely linked in the calculation and rating of a transmission. Instructed company in the critical temperature concept and the minimum film thickness concept. Both these calculations require the use of imperical data taken from a source such as AGMA.	1a Consultant wrote a letter in behalf of the company to AGMA and will continue to follow up until the company receives AGMA 218.	This company has a large design staff. The individual citing the problems was a design engineer, hence all the problems were related to design. It is unfortunate that the consultant was not able to bring a copy of the new AGMA 218 as the company and the consultant could have benefited from reviewing the new standard together. Many of the subjects undertaken were very abstract and complex.

SUMMARY REPORT 5TH YEAR KCGF/GIT PROJECT
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Company Product	Visit Dates KCGF Staff	Preselected Problems	New Problems	Current Action	Future Action	Observations
-N- Jeil Engnr & Industrial Co. Gears xmissions	5/18 Shin 5/30 Shin 6/14 Shin			6. Instructed the company in design guidelines for quiet transmissions. Also instructed in methods to minimize noise in existing transmissions. 7. Presented the company with four USSR Research papers on Novikov gearing. Discussed the high points in the materials. Generally Novikov gearing is used in high speed, low load, low noise application.		Many relate only to high speed transmissions. They don't have relevance to the company's line of low speed reducers. However, the company seeks to produce high speed transmissions in the near future and in this case the information will be quite useful.